Chapter: 24

State(s): Washington

Recovery Unit Name: Snake River Washington

Region 1
U.S. Fish and Wildlife Service
Portland, Oregon

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SNAKE RIVER WASHINGTON RECOVERY UNIT
CHAPTER OF THE BULL TROUT RECOVERY PLAN

EXECUTIVE SUMMARY

CURRENT SPECIES STATUS

The U.S. Fish and Wildlife Service issued a final rule listing the Columbia River population of bull trout as a threatened species on June 10, 1998 (63 FR 31647). The Snake River Washington Recovery Unit forms part of the range of the Columbia River Distinct Population Segment. The Snake River Washington Recovery Unit encompasses selected tributaries of the mainstem Snake River from Lower Monumental Dam at river kilometer 68 (river mile 42) upstream to the mouth of the Grande Ronde River at river kilometer 272 (river mile 169). Lower Monumental Dam is operated by the U.S. Army Corps of Engineers. The Tucannon River and Asotin Creek watersheds contain the only known bull trout core populations in the Snake River Washington Recovery Unit.

In portions of the Snake River Washington Recovery Unit, bull trout have been extirpated from their former habitat. Other local populations may be fragmented and isolated in headwater locations because of natural or manmade barriers. Although current data and records that describe the historic distribution of bull trout throughout the Snake River Washington Recovery Unit are limited, observations indicate that mainstem reaches and many tributaries within the Tucannon River and Asotin Creek watershed were, or still are, occupied or utilized by bull trout at various life stages. Also, other information strongly suggests that bull trout from tributaries in the Tucannon River and Asotin Creek watersheds migrated into the mainstem Snake River, presumably to forage and overwinter. Because of credible anecdotal accounts, the Snake River Washington Recovery Unit Team believes that before habitat was significantly modified, fluvial bull trout used Asotin Creek just as they use the Tucannon River. In recent years, bull trout have not been found in some of the tributaries where they were earlier documented, and local populations of these fluvial forms have perhaps been lost.

The Snake River Washington Recovery Unit Team has identified the Tucannon River and Asotin Creek basins as separate core areas within the Snake River Washington Recovery Unit. Current knowledge indicates that local populations within the recovery unit consist of migratory and resident life history forms. Migratory forms include fluvial bull trout that overwinter in the mainstem Tucannon River and fish that may overwinter in and then migrate from locations in the mainstem Snake River at least as far downstream as the Lower Monumental Dam pool.

HABITAT REQUIREMENTS AND LIMITING FACTORS

A detailed discussion of bull trout biology and habitat requirements is provided in Chapter 1 of this recovery plan. The limiting factors discussed here are specific to the Snake River Washington Recovey Unit. Within the Snake River Washington Recovery Unit, historical and current land use activities have impacted bull trout local populations. Some of the historical activities, especially construction of low head dams in the early 1900's, may have significantly reduced important fluvial populations. A combination of human-induced factors have affected bull trout, including till crop production and irrigation withdrawals, livestock grazing, logging, hydropower production, introduction and management of nonnative species, urbanization, and transportation networks. Lasting effects from some, but not all, of these early land and water developments still limit bull trout production in both the Tucannon River and Asotin Creek Core Areas. Three flood events have occurred in the Tucannon River and Asotin Creek watersheds since 1964. The degraded conditions of the stream corridors prior to the floods, especially the conversion of floodplains into agricultural land and road networks, resulted in even greater damage from the floods than would have been expected and reduced the ability of the Tucannon River and Asotin Creek to recover natural fluvial function. After each flood, increasingly severe channel modifications were made to protect roads and agricultural land that is situated in the floodplain.

RECOVERY GOALS AND OBJECTIVES

The goal of the bull trout recovery plan is to **ensure the long-term persistence of self-sustaining, complex, interacting groups of bull trout distributed throughout the species' native range, so that the species can be delisted.** To achieve this goal, the following objectives have been identified for bull trout in the Snake River Washington Recovery Unit:

- Maintain current distributions of bull trout and restore distributions in previously occupied areas within the Snake River Washington Recovery Unit.

- Maintain stable or increasing trends in adult bull trout abundance.

- Restore and maintain suitable habitat conditions for all life history stages and forms.

- Conserve genetic diversity and provide opportunity for genetic exchange.

RECOVERY CRITERIA

Recovery criteria for the Snake River Washington Recovery Unit are established to assess whether actions are resulting in the recovery of bull trout in the basin. The criteria developed for bull trout recovery address quantitative measurements of bull trout distribution and population characteristics on a recovery unit basis.

1. **Distribution criteria will be met when the total number of stable local populations has increased to 10 in the Tucannon River Core Area and to 7 in the Asotin Creek Core Area.** These local populations must occur in separate streams with broad distribution throughout each core area.

2. **Trend criteria will be met when the overall bull trout population in each core area of the Snake River Washington Recovery Unit is stable or increasing over a period of at least 10 years, as determined through contemporary and accepted analyses of abundance trend data.**

3. **Abundance criteria will be met when the Tucannon River Core Area supports an average of 1,000 spawners annually and when the Asotin Creek Core Area supports an average of 700 spawners annually.**

4. **Connectivity criteria will be met when migratory forms are present in all local populations and when intact migratory corridors among all local populations in both core areas provide opportunity for genetic exchange and diversity.**

ACTIONS NEEDED

Recovery for bull trout will entail reducing threats to the long-term persistence of local populations and their habitats, ensuring the security of multiple interacting groups of bull trout, and providing habitat conditions and access to conditions that allow for the expression of various life history forms. Seven categories or actions needed are discussed in Chapter 1; tasks specific to this recovery unit are provided in this chapter.

ESTIMATED COST OF RECOVERY

The total cost for bull trout recovery in the Snake River Washington Recovery Unit is estimated at $1.6 million. Total costs include estimates of expenditures by local, Tribal, State, and Federal governments and by private business and individuals. These costs are attributed to bull trout conservation but other aquatic species will also benefit. Cost estimates are not provided for tasks which are normal agency responsibilities under existing authorities.

ESTIMATED DATE OF RECOVERY

Time required to achieve recovery depends on bull trout status, factors affecting bull trout, implementation and effectiveness of recovery tasks, and responses to recovery tasks. A tremendous amount of work will be required to restore impaired habitat, reconnect habitat, and eliminate threats from nonnative species. For the Tucannon River Core Area, a minimum of four to five bull trout generations (20 to 25 years) will probably pass before high-priority recovery actions can significantly reduce identified threats to bull trout and populations exhibit positive, recovery level responses. However, the recovery unit team expects local population trends (*i.e.*, redd counts) to increase concurrently, or with minimal time lag, following implementation of recovery activities. Recovery criteria should be met within four to five generations (20 to 25 years).

For the Asotin Creek Core Area, however, initiating a controlled propagation program will be necessary to accelerate recovery time. This propagation program would begin only after a suitable genetic source (preferably from bull trout within the basin) is identified and a stream inventory and analysis (feasibility study) is completed. This analysis would identify habitats that meet minimum criteria (*e.g.*, for stream size, gradient, flow, groundwater contributions, temperature, pools and spawning substrate, and riparian cover) to support local populations or that, with minimal improvements, could support local populations of bull trout. Because a stream analysis and development of a controlled propagation program could take up to five years, recovery within the Asotin Creek Core Area may take one to two additional generations (5 to 10 years) beyond the four to five generations needed to significantly reduce identified threats. Under this scenario, we expect that recovery criteria for the Asotin Creek Core Area could be achieved within five to seven bull trout generations (25 to 35 years).

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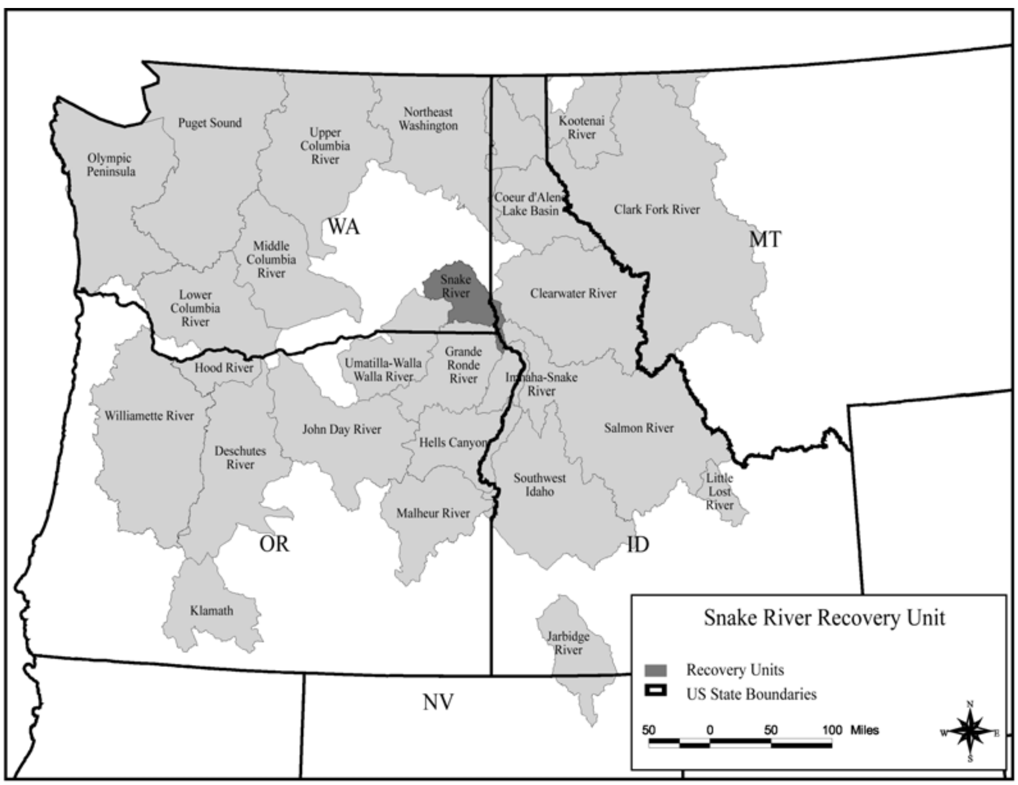
INTRODUCTION

Recovery Unit Designation

The Snake River Washington Recovery Unit is one of 22 recovery units designated for bull trout in the Columbia River basin (Figure 1). This recovery unit encompasses a portion of the Snake River basin between Lower Monumental Dam at river kilometer 68 (river mile 42) upstream to the Grande Ronde River at river kilometer 271 (river mile 168) and all tributaries within this reach. The Tucannon River and Asotin Creek are the only two tributaries to this stretch of the Snake River that are known to contain reproducing bull trout populations.

Figure 1. Bull trout recovery units in the United States. The Snake River Washington Recovery Unit is highlighted.



Two core areas are designated for the Snake River Washington Recovery Unit: the Asotin Creek Core Area and the Tucannon River Core Area (Figure 2). The Palouse River lies within the Snake River Washington Recovery Unit but does not currently contain a bull trout population. Couse Creek and Tenmile Creek enter the Snake River in this reach and are also included in the Snake River Washington Recovery Unit, but they are not believed to contain bull trout at this time. The Clearwater and Grande Ronde Rivers are large tributaries to the Snake River within this reach, but they have been placed in separate recovery units. Watershed boundaries of the Snake River Washington Recovery Unit overlap ceded lands of the Nez Perce Tribe; the Nez Perce and other Native American Tribes have treaty fishing rights here.

Figure 2. Snake River Washington Recovery Unit for bull trout.

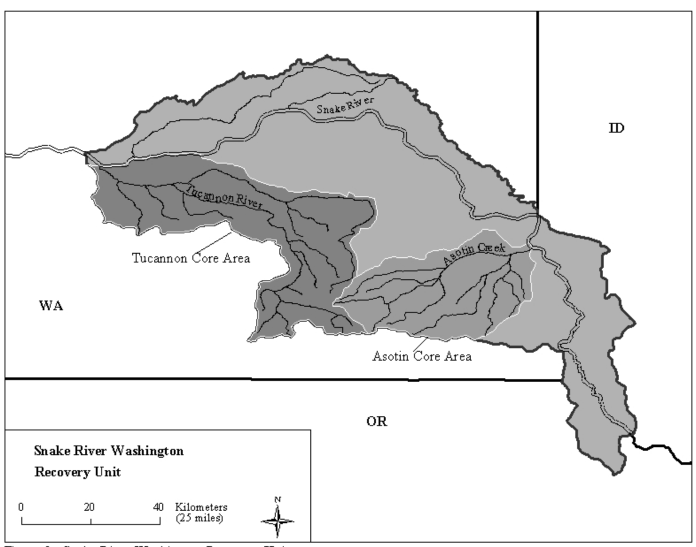


Figure 2. Snake River Washington Recovery Unit.

Geographic Description

Tucannon River Core Area. The Tucannon River watershed is located in southeastern Washington and is a tributary to the Snake River (Figure 3). Headwaters of the Tucannon River are in the northernmost part of the Blue Mountains. The Tucannon River watershed contains a total area of 129,996 hectares (321,228 acres), of which 30,351 hectares (75,000 acres) were classified by the Soil Conservation Service as forested area (Gephart and Nordheim 2001). Lands within the Umatilla National Forest total nearly 32,375 hectares (80,000 acres). There are 5,004 hectares (12,366 acres) of U.S. Forest Service lands in the Wenaha-Tucannon Wilderness area. The mean annual flow of the Tucannon River is 5 cubic meters per second (177 cubic feet per second) at its mouth. The minimum observed flow was 0.42 cubic meter per second (15 cubic feet per second), and the maximum was more than 226 cubic meters per second (7,980 cubic feet per second) in December 1964 (Gephart and Nordheim 2001).

Figure 3. Tucannon River Core Area with major drainages shown.

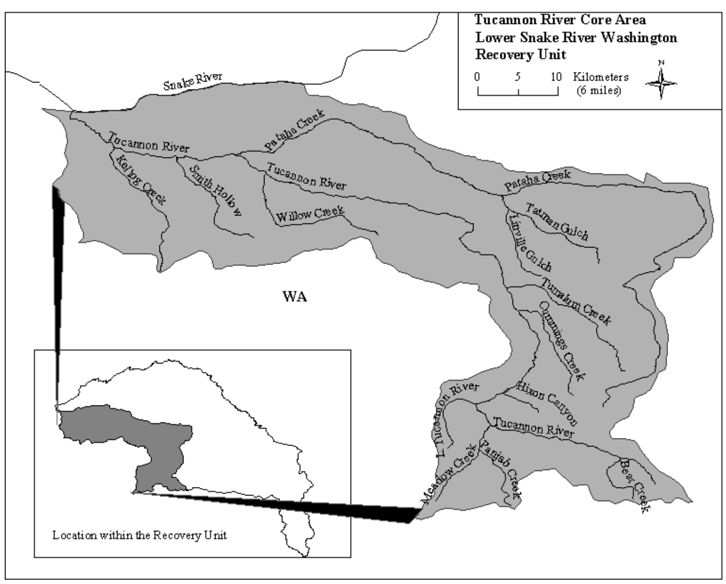


Figure 3. Tucannon River Core Area for Bull Trout within the Snake River Washington Recovery Unit.

The Blue Mountains in the headwaters of the Tucannon River watershed are composed of uplifted Columbia River flood basalt. These basalt flows are layered, with individual flows averaging 31 meters (100 feet) in thickness. Total thickness of the formation exceeds 900 meters (several thousand feet) (McKee 1972). The Tucannon River watershed is generally composed of V-shaped drainages having steep sides and narrow canyons. The steep terrain is the result of extensive folding and faulting associated with formation of the Blue Mountains. Geology of the basin consists of consolidated rock formed from Columbia River basalt that was overlain by volcanic ash from the eruption of Mount Mazama.

Columbia River basalts were formed from high-volume fissure eruptions of the Columbia Plateau, a flat featureless geologic province that existed before the Blue Mountains were uplifted. The surface of each basalt flow cooled as the underlying basalt was still flowing. Over time, the upper layer was broken by erosion to form a layer of rubble, while the underlying basalt had formed a more solid rock that is relatively impervious to water flow. As each successive lava eruption poured another layer of basalt over the previous flow, a series of alternating layers of rubble and solid rock were built up. The rubble layers form excellent aquifers and, when exposed by erosion, often create springs.

After the uplifting of a portion of the Columbia River flood basalt (formation of the Blue Mountains), water erosion began forming deep V-shaped drainages. When the heads of these drainages cut into the uplifted basalt, relatively sharp ridges were produced between adjacent drainages. Where the heads of the drainages have not met, flat uplands exist. The majority of the Tucannon River watershed has sharp ridge tops, and access is difficult in the upper portion. The southern edge of the watershed is relatively flat and more accessible.

The eruption of Mount Mazama in Oregon about 6,850 years ago deposited a layer of volcanic ash over much of the Blue Mountains. In general, erosion has removed most of the ash from the ridge tops and south-facing slopes, but it is still present on many of the north-facing slopes and flat upland areas.

Soils formed by the volcanic ash are moderately deep and medium textured and have high infiltration rates and water-holding capacity. These soils are highly sensitive to compaction and are easily eroded. Residual soils formed from the basalt flows are generally shallow and relatively fine textured with little water-holding capacity (Ehmer 1978).

Elevation of the basin varies from approximately 152 meters (500 feet) at the mouth of the Tucannon River to 1,947 meters (6,387 feet) at Oregon Butte, its highest point. The change in elevation results in climatic variations, with cooler, moist conditions occurring at the higher elevations. Rainfall varies from 25 centimeters (10 inches) at the mouth of the Tucannon River to more than 102 centimeters (40 inches) in the higher elevations. Ninety percent of the precipitation occurs between September 1 and May 30. Average annual air temperature for the entire basin is 17 degrees Celsius (63 degrees Fahrenheit). Mid-summer air temperatures range from 29 to 32 degrees Celsius (85 to 90 degrees Fahrenheit), and mid-winter temperatures range from 2 to 4 degrees Celsius (35 to 40 degrees Fahrenheit). Air temperature extremes range from –30 to 43 degrees Celsius (–22 to 110 degrees Fahrenheit) (SCS 1984).

The Pataha Creek watershed is located in western Garfield County and eastern Columbia County in southeast Washington. Pataha Creek is the largest tributary to the Tucannon River, draining 49,336 hectares (121,912 acres). The climate of the area is influenced primarily by continental weather patterns with moderating influence from marine air masses from the Pacific Ocean. The average annual precipitation ranges from 20 centimeters (8 inches) at lower elevations to over 114 centimeters (45 inches) in upper reaches of the watershed. Most of the precipitation occurs between September and June. Temperatures range from –30 degrees Celsius (–22 degrees Fahrenheit) in winter to 43 degrees Celsius (109 degrees Fahrenheit) in the summer. The frost-free growing season of the watershed averages 110 to 140 days (PCD 1998).

Topography of the watershed is primarily long slopes intersected by steep canyons. Most of the land having slopes of up to 45 percent, except for forested land, is under cultivation. The landforms are mainly flat to moderately sloping.

Elevations range from 274 meters (900 feet) above sea level at the confluence of Pataha Creek with the Tucannon River to 1,707 meters (5,600 feet) at the watershed's highest point (PCD 1998).

Asotin Creek Core Area. The Asotin Creek watershed is located in southeastern Washington and is a direct tributary of the Snake River (Figure 4). The name "Asotin" is derived from the Nez Perce description of "Hash Otin," meaning "Eel Creek" (ACMWP 1995). The Nez Perce name implies that Asotin Creek had a large run of Pacific lamprey (*Entosphenus tridentatus*). Pacific lamprey adults were observed in Asotin Creek prior to 1980 (ACMWP 1995). Pacific lamprey have a migratory life history similar to that of spring chinook salmon (*Oncorhynchus tshawytscha*), a species that also historically used Asotin Creek. Pacific lamprey are known to require clean substrate and cool water temperatures for spawning, requirements that probably indicate stream conditions present in Asotin Creek before land was disturbed in the 1900's.

The headwaters of the Asotin Creek are in the northeasternmost part of the Blue Mountains. The Asotin Creek watershed is generally composed of V-shaped drainages with steep-sided, mostly narrow, canyons. The steep terrain is the result of extensive folding and faulting associated with formation of the Blue Mountains. Geology of the basin consists of consolidated rock formed from Columbia River basalt, overlain by volcanic ash from the eruption of Mount Mazama. In general, erosion has removed much of the ash from the ridge tops and south-facing slopes, but this material is still present on many of the north-facing slopes. Soils formed by this volcanic ash are moderately deep and medium textured and have high infiltration rates and water-holding capacity. Soils composed of ash are also highly sensitive to compaction and are easily eroded.

Figure 4. Asotin Creek Core Area with major drainages shown.

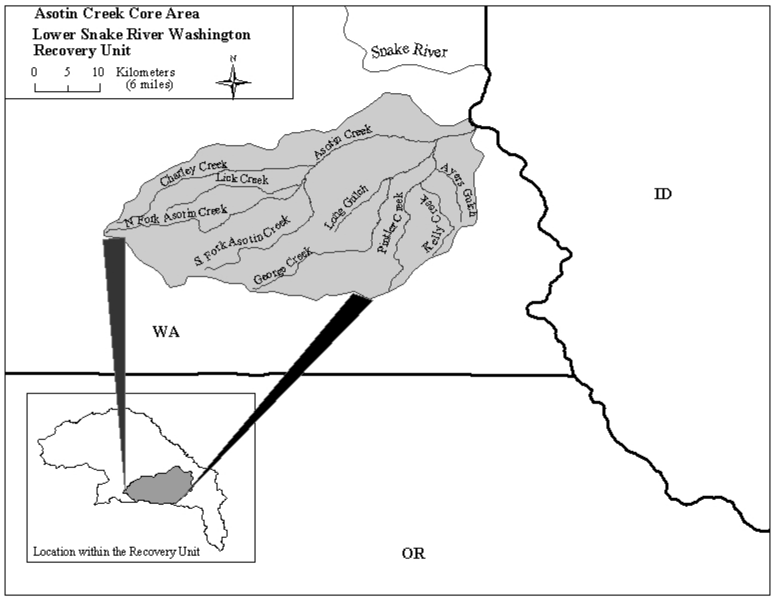


Figure 4. Asotin Creek Core Area for Bull Trout within the Snake River Washington Recovery Unit.

Residual soils formed from the basalt flows are generally shallow and relatively fine textured, with little water-holding capacity (Ehmer 1978).

While riparian zones within the Asotin Creek watershed were considered "moderately stable" in 1974 with regard to erosion and hydrology, more recent inventories indicate that riparian conditions in Asotin Creek vary widely by stream, location, and land use. The U.S. Forest Service (1992b) reported that grand fir (*Abies grandis*), ponderosa pine (*Pinus ponderosa*), and Douglas-fir (*Psuedotsuga menziesii*) comprise the dominant conifer overstory in riparian zones of the North Fork of Asotin Creek. Canopy cover in North Fork Asotin Creek averaged 39 percent in 1992. Grand fir and Douglas-fir are also the dominant species in the riparian zones of the South Fork of Asotin Creek and Cougar Creek. Logging operations took place adjacent to Cougar Creek more than 10 years ago. Some trees exceeding 4 meters (12 feet) in height are now regenerating along logged riparian areas (D. Groat, U.S. Forest Service, pers.

comm., 2002b). Alder (*Alnus* species) and, to a lesser extent, mallow ninebark (*Physocarpus malvaceus*) dominate the understory in areas where secondary vegetation is present. In other streams, such as Lick Creek, riparian zones are in poor condition along some reaches; clear-cuts were used to harvest timber immediately adjacent to the stream edge, and trees have not reestablished there. On State lands in the North Fork Asotin Creek drainage upstream from Dry Lick Creek, riparian zones are recovering from flood damage incurred in 1973 and subsequent salvage timber harvest (USFS 1992b). Streams in the upper watershed are generally reported to contain higher-quality riparian zones compared with lower reaches where more streamside activities occur (Kuttel 2002).

Elevation of the basin varies from approximately 232 meters (760 feet) at the mouth of Asotin Creek to 1,897 meters (6,223 feet) at Mount Misery. The change in elevation results in climatic variations, with cooler, moist conditions occurring at the higher elevations. Rainfall varies from 36 centimeters (14 inches) at the mouth of Asotin Creek to more than 140 centimeters (55 inches) in the higher elevations, with 90 percent of the precipitation occurring between September 1 and May 30. Average annual temperature for the entire basin is 17 degrees Celsius (63 degrees Fahrenheit), with mid-summer temperatures of 29 to 32 degrees Celsius (85 to 90 degrees Fahrenheit), mid-winter temperatures of 2 to 4 degrees Celsius (35 to 40 degree Fahrenheit), and temperature extremes from –32 to 40 degrees Celsius (–25 to 104 degrees Fahrenheit) (SCS 1982).

The Asotin Creek watershed contains a total area of 82,823 hectares (204,660 acres), of which 33,755 hectares (83,410 acres) were classified as forested area by the Soil Conservation Service in 1982; the remainder is classified as rangeland or cropland (SCS 1982). Lands within the Umatilla National Forest boundary total 29,499 hectares (65,480 acres). This total includes 947 hectares (2,340 acres) of State and private holdings. U.S. Forest Service lands total 25,552 hectares (63,140 acres). Forested lands comprise 40 percent of the land area in the watershed; non-irrigated cropland comprises 29 percent, and rangelands total approximately 30 percent of the watershed. Survey figures show 23,934 hectares

(59,141 acres) were used for crops, mainly wheat and barley. One percent is classified as "other," which includes rural farms and towns (SCS 1982).

The Asotin Creek watershed has approximately 579 kilometers (360 miles) of perennial and intermittent streams. The mainstem of Asotin Creek is approximately 55 kilometers (34 miles) long, with 42 kilometers (26 miles) designated as Class I (anadromous fish bearing), 8 kilometers (5 miles) designated as Class II (resident fish bearing), and 3 kilometers (2 miles) as Class III (perennial non-fish bearing) (USFS 1998b). Asotin Creek has about 7.2 kilometers (4.5 miles) of habitat that produces chinook salmon.

Mean annual flow at the mouth of Asotin Creek is about 2.2 cubic meters per second (76 cubic feet per second), with a bank-full width of 25 meters (83 feet). Maximum recorded flows were measured at 184 cubic meters per second (6,500 cubic feet per second) in 1964 at a U.S. Geological Survey gauge located at river kilometer 14.0 (river mile 8.7). The lowest recorded flow was 0.4 cubic meter per second (13 cubic feet per second) in 1963 (Stoval 2001).

DISTRIBUTION AND ABUNDANCE

Status of Bull Trout at the Time of Listing

In the final listing rule (63 FR 31647), the U.S. Fish and Wildlife Service identified four subpopulations of bull trout occurring within the Snake River Washington Recovery Unit. These subpopulations included one in the Tucannon River and one that was reported to exist in Pataha Creek, the largest tributary to the Tucannon River. The other two subpopulations initially identified were in North Fork Asotin Creek and Charley Creek, both tributaries to Asotin Creek (USFWS 1998). At the time of listing (June 1998), the Tucannon River subpopulation was suppressed by habitat degradation, but it was not at immediate risk of extinction because most spawning and rearing locations are within protected areas of the Wenaha-Tucannon Wilderness in the upper Tucannon River watershed. Although subpopulations were an appropriate unit upon which to base the 1998 listing decision, the recovery plan has revised the biological terminology to better reflect the current understanding of bull trout life history and conservation biology theory. Therefore, subpopulation terms will not be used in this chapter.

Current Distribution and Abundance

Both resident and migratory forms of bull trout occur in the Tucannon River basin (Martin *et al*. 1992; WDFW 1997). Migratory bull trout from the Tucannon River probably also use the mainstem Snake River on a seasonal basis (Kleist, *in litt*., 1993; Underwood *et al*. 1995; WDFW 1997). Each spring during salmon and steelhead (*O. mykiss*) collections, between 30 and 40 adult bull trout up to 65 centimeters (26 inches) long are captured and released upstream of a weir at the Tucannon River Fish Hatchery (G. Mendel, Washington Department of Fish and Wildlife, pers. comm., 2002c). Martin *et al*. (1992) reported capturing four adult bull trout larger than 61 centimeters (24 inches) at the Tucannon Hatchery anadromous fish trap in the spring of 1991. Although there is substantial evidence that some Tucannon River bull trout use the Snake River during a portion of their life cycle, studies have not been conducted to provide direct documentation.

Anecdotal accounts describe anglers catching large migratory bull trout from Asotin Creek in the early 1970's (Groat, pers. comm., 2002c). The reported size (50 centimeters [20 inches]) of these fish indicates that they probably used the mainstem Snake River to forage and overwinter.

Kleist (*in litt*. 1993) reported several observations of adult bull trout passing Lower Monumental and Little Goose Dams on the mainstem Snake River. The U.S. Army Corps of Engineers summarized occurrences of adult bull trout seen in fish ladders and captured in juvenile bypass sampling systems at Lower Monumental Dam and Ice Harbor Dam facilities (Baxter, *in litt*., 2002). Since 1993, fish facility personnel have documented a total of 37 bull trout at both projects. Length estimates for these fish ranged between 20 and 46 centimeters (8 to 18 inches). It is very possible that these fish are migratory fish returning to, or migrating from, the nearby Tucannon River, rather than fish migrating to streams significantly farther upstream. Fish passage personnel have not documented adult bull trout passing Lower Granite Dam (R. Baxter, U.S. Army Corps of Engineers, pers. comm., 2002). Juvenile bull trout have been captured in juvenile salmon bypass systems at Lower Granite Dam (Groat, pers. comm., 2002d). In the past, fish counters at Lower Granite Dam may not have documented passing bull trout because counting protocol instructed individuals to tally only "core" anadromous species (Baxter, pers. comm., 2002).

Table 1 lists the streams where spawning is known to occur in the Tucannon River and Asotin Creek Core Areas. Bull trout populations in the Tucannon River were rated as "healthy" in 1997 by the Washington Department of Fish and Wildlife (1997) based on a single population estimate conducted in 1992 by Martin *et al*. (1992) and by spawning surveys conducted by the U.S. Forest Service and Washington Department of Fish and Wildlife. Redd count data presented by the Washington Department of Fish and Wildlife (1997) is from a 12.1-kilometer (7.5-mile) reach between Panjab and Bear Creeks and not from all spawning locations in the Tucannon River watershed (Mendel, pers. comm., 2002b). Redd counts that were conducted intermittently between 1991 and 2000 ranged from 57 redds in 1991 to 222 redds in 1999. Counts averaged 123 redds for all years. While the peak count occurred in 1999 (222 redds), the number of stream miles surveyed that year was nearly double (49 kilometers compared with

Table 1. Streams in the Tucannon River Core Area (8) and Asotin Creek Core Area (2) where bull trout are known to spawn. Indentation of a stream name indicates that it is a tributary to the stream named directly above it.

RECOVERY UNIT	CORE AREA	KNOWN SPAWNING STREAMS
Snake River Washington	**Tucannon River**	1) upper Tucannon River (river kilometer 78 to 93)
		2) Bear Creek
		3) Sheep Creek
		4) Cold Creek
		5) Panjab Creek
		6) Meadow Creek
		7) Little Turkey Creek
		8) Turkey Creek
Snake River Washington	**Asotin Creek**	(1) North Fork Asotin Creek
		(2) Cougar Creek

26 kilometers [31 miles compared with 16 miles]) that of any other year (Gephart and Nordheim 2001). Significant differences in spawning survey protocol (*i.e.*, different survey locations, different survey distances, and the number of subsequent surveys per site) occurred from year to year, and such differences make drawing conclusions about spawning trends and adult abundance difficult.

In addition to the upper Tucannon River, bull trout currently spawn in seven other tributaries. These streams include the mainstem of Panjab Creek and several of its tributaries; Turkey Creek and Meadow Creek; and Little Turkey Creek, a tributary to Meadow Creek. Bull trout also spawn in Sheep, Cold, and Bear Creeks, all upper Tucannon River tributaries. In 1992, the U.S. Forest Service observed 142 juvenile bull trout during snorkeling surveys in a 17-

kilometer (11-mile) section of Cummings Creek (USFS 1992c). Spawning surveys have not been conducted in Cummings Creek.

Genetic work has not been initiated to substantiate genetic differences between fish in Panjab Creek or any of the other tributaries used by bull trout. Some spawning streams in the upper Tucannon River watershed are very close to one another. The Snake River Washington Recovery Unit Team concludes that this situation might promote free movement among spawning areas from one year to the next and, therefore, result in a single population of fish with a common genetic make-up using more than one stream for spawning and rearing.

The Snake River Washington Recovery Unit Team engaged in substantial discussion about Panjab Creek bull trout to determine whether one or more local populations exist in the Panjab Creek watershed. After reviewing the best available rangewide information on bull trout movement, population genetics, and spawning characteristics (Leary *et al*. 1992; James *et al.*, *in litt*., 1998; Spruell and Allendorf 1998; Dunham and Rieman 1999; Rieman and Dunham 2000; Spruell *et al*. 2000; Hvenegaard and Thera 2001; Rieman and Allendorf 2001; Baxter 2002), the Snake River Washington Recovery Unit Team designated Panjab Creek and each of its colonized tributaries as separate local populations. Until the necessary genetic work is completed, Panjab Creek, Turkey Creek, Meadow Creek, and Little Turkey Creek are considered separate local populations. It will be important to monitor spawning characteristics and conduct genetic research on each spawning population in the Tucannon River Core Area, especially in Panjab Creek. The Snake River Washington Recovery Unit Team emphasizes that genetic work is an important management need and research priority to verify the genetic characteristics and population structure of Tucannon River bull trout.

Bull trout currently inhabit portions of the upper mainstem of Asotin Creek, North Fork Asotin Creek, Cougar Creek, the Middle Branch and South Fork of North Fork Asotin Creek, and South Fork Asotin Creek. North Fork Asotin Creek and Cougar Creek are the only streams where spawning has been documented (Table 1). Juvenile and subadult bull trout rear in the mainstem of Asotin Creek from Charley Creek upstream to the confluence of North Fork and

South Fork Asotin Creeks (known as "the Forks"). Juveniles also rear in lower North Fork Asotin Creek and in the Middle Branch and the South Fork of North Fork Asotin Creek. Historically, bull trout may have also been present in the South Fork Asotin Creek drainage, but they were not found during 1992 snorkeling surveys by the U.S. Forest Service (USFS 1992i). Additional electrofishing surveys should be conducted to verify that bull trout are absent from this stream. The upper reaches of South Fork Asotin Creek still have some potential habitat to support bull trout.

The Washington Department of Fish and Wildlife (1997) reported that historically, migratory bull trout probably used Asotin Creek. The agency conducted redd count surveys in North Fork Asotin Creek in 1996, 1997, and 1999, Cougar Creek in 1999, and Charley Creek in 1998, 1999, and 2000. The Washington Department of Fish and Wildlife (1997) describes the status of Asotin Creek core population as "unknown." Table 2 shows the years in which redd surveys were performed in the Tucannon River and Asotin Creek watersheds and the number of redds observed. Redd survey methods varied from year to year as both multiple pass surveys (preferred redd survey method where two surveys are conducted in the same stream reach separated by about two weeks time) and single pass surveys were used.

In 1991, Martin *et al*. (1992) conducted habitat surveys and population estimates for bull trout in portions of the Tucannon River and Asotin Creek. They estimated that a combined total of 4,853 young-of-the-year and juvenile bull trout were present within a 17-kilometer (11-mile) reach of the mainstem Tucannon River from the mouth of the Little Tucannon River upstream to Bear Creek. To obtain a population estimate, Martin *et al.* (1992) applied estimated bull trout densities across available habitat areas comprised of five different habitat types (scour pool, plunge pool, run, riffle, and cascade), though they sampled only a small percentage (5.6 percent) of each habitat type available and captured a total of only 56 bull trout in electrofishing samples. In addition, electrofishing sample sites were located in only four of the six habitat reaches, though bull trout densities were extrapolated into fish numbers for all six reaches.

Table 2. Bull trout redd counts in the Tucannon River and Asotin Creek Core Areas. Counts reflect multiple pass surveys in some years, but not all years (Gephart and Nordheim 2001; Mendel, pers. comm., 2002b; USFS, *in litt*., 2002).

	YEAR / REDD COUNT										
WATERSHED	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
kilometers surveyed	21	17	ns	14	19	26	30	28	49	29	6
Tucannon River											
Upper Tucannon	57	66	ns	127	115	167	74	104	135	95	68
Bear Creek	ns	ns	ns	4	ns	3	ns	4	26	49	ns
Sheep Creek	ns	ns	ns	ns	ns	ns	ns	ns	2	ns	ns
Cold Creek	ns	ns	ns	ns	ns	ns	ns	ns	2	ns	ns
Panjab Creek	ns	ns	ns	ns	7	9	4	0	15	ns	ns
Turkey Creek	ns	ns	ns	ns	ns	ns	ns	ns	8	ns	ns
Meadow Creek	ns	ns	ns	ns	2	4	0	0	25	7	ns
Little Turkey Creek	ns	ns	ns	ns	ns	ns	ns	ns	8	ns	ns
Asotin Creek											
NF Asotin Creek	ns	ns	ns	ns	ns	3	0	ns	59	ns	ns
Cougar Creek	ns	ns	ns	ns	ns	0	ns	ns	9	ns	ns
Charley Creek	ns	ns	ns	ns	ns	ns	ns	0	0	0	ns

ns = not surveyed

Martin *et al.* (1992) and Underwood *et al.* (1995) reported that bull trout abundance in Asotin Creek is very low. In a two year sampling period in which 16 sites (1,250 square meters [13,456 square feet]) were surveyed (electrofishing) for population estimates, Martin *et al.* (1992) captured only two bull trout and therefore were unable to estimate a population size. Three additional bull trout were sampled during efforts to determine relative abundance in other portions of the watershed. From these surveys, they concluded that the population status in Asotin Creek was probably at increased risk from genetic drift. In 1991, juvenile density was estimated at 0.4 fish per 100 square meters in North Fork Asotin Creek (WDFW 1997); more recent estimates are not available. The remainder of the data associated with the status of Asotin Creek bull trout consists of infrequent observations during U.S. Forest Service surveys; during 1993 ocular surveys, 21 bull trout were observed in the North Fork Asotin Creek and Charley Creek watersheds combined (WDFW 1997).

In March, 1998, biologists from the U.S. Geological Survey Western Fisheries Research Center caught a single 20-centimeter (8-inch) bull trout while backpack electrofishing the large plunge pool below Palouse River Falls (Rubin, *in litt*., 1998). This bull trout observation is the only one known by the recovery unit team for the Palouse River. Currently, we do not know whether bull trout are present in smaller tributaries within the Snake River Washington Recovery Unit (*e.g.*, Couse, Tenmile, Almota, Steptoe, and Canyon Creeks). More detailed surveys in these tributaries are necessary to verify presence or absence.

REASONS FOR DECLINE

Within the Snake River Washington Recovery Unit, historical and current land use activities have impacted bull trout local populations. Some of the historical activities, especially construction of low head dams in the early 1900's within the core areas, may have significantly reduced important fluvial populations. Lasting effects from some, but not all, of these early land and water developments still act to limit bull trout production in both the Tucannon River and Asotin Creek Core Areas. Threats from current activities are also present in both core areas of the Snake River Washington Recovery Unit. Below, we discuss the historical and current human-induced factors that limit bull trout.

Dams

The mainstem of the Snake River in Washington is probably used by bull trout as deep water habitat for overwintering and feeding. While some research and monitoring is now taking place, and more is planned, the percentage of populations that likely use the Snake River as a routine part of their life history is currently unknown. We do know that bull trout encounter mainstem dams on the lower and upper Snake River. How bull trout deal behaviorally with passage at dams is not known. Consequently, we do not know how the presence and operations of mainstem dams will affect recovery of bull trout in the Snake River Washington Recovery Unit. Therefore, we have not included the mainstem of the Snake River in either core area of the Snake River Washington Recovery Unit, but have recommended research on these issues to clarify the impact of mainstem dams on fluvial bull trout and to determine the significance of dams in relation to recovery.

Smaller dams within the Tucannon River and Asotin Creek watersheds may have had significant historical impacts on fluvial bull trout populations in both streams. Two of these dams are still present and may be affecting bull trout migrations. Historical accounts of these dams are discussed below.

Tucannon River Core Area. Construction of dams for power and irrigation occurred before 1909 in the Tucannon River watershed. At least two dams built across the Tucannon River channel had documented impacts on salmon and undoubtedly impacted bull trout as well.

Parkhurst (1950) compiled results of fish surveys performed on the Snake River and most of its tributaries from 1935 to 1937 for a special scientific fisheries report for the U.S. Fish and Wildlife Service. Three fish surveyors working for the U.S. Fish and Wildlife Service in 1935 described a dam at Starbuck on the Tucannon River at approximately river kilometer 8.9 (river mile 5.5). Starbuck Dam was built in 1907 by a local physician to produce electricity for the community of Starbuck on the Tucannon River. It replaced another dam that had been built for the operation of a gristmill. Starbuck Dam was 1.5 meters high (5.0 feet), 29 meters (95 feet) long, and diverted water through a penstock to a power plant about 1.6 kilometers (1.0 mile) downstream. A water right was recorded in 1909 for this dam at 5.7 cubic meters per second (200 cubic feet per second), which exceeded river discharge. Another diversion at Starbuck Dam simultaneously routed water out of the pond above the dam for irrigation. In February 1935, surveyors noted that nearly the entire river flow was diverted, and in summer months, the river channel for 1.6 kilometers (1.0 mile) was virtually dry between the dam and the power plant tailrace downstream. The main fish attraction flows were below the power plant where no fish ladder existed. On February 3, 1935, the penstock diversion at the dam measured 1.6 cubic meters per second (55.5 cubic feet per second), while the irrigation diversion withdrew 0.3 cubic meter per second (11 cubic feet per second). The penstock to the power plant was screened, but the irrigation diversion was not.

In 1992, the Washington Department of Fish and Wildlife built a new fish ladder at Starbuck Dam that is open only in October through December to allow fall chinook to pass. A notch was cut in the center of the structure to allow water to cascade through during the spring and summer. The current intent of the notch and ladder is to allow upstream passage of adult anadromous fish in the spring and summer, but to block the passage of nongame fish that are unable to overcome higher water velocity and jump through the notch. Bull trout are believed to be able to pass, but no efficiency information exists. There is some concern about whether juvenile or subadult bull trout can pass this structure.

Early descriptions of the dam indicate that it probably had significant impacts on fluvial bull trout that migrated up the Tucannon River in the spring to spawn and down the river in the fall after spawning. The screen widths of the apparatus used on the upstream end of the turbine penstock probably did not keep juvenile fish from passing through. If the mesh size was small enough to keep small fish from being entrained into the penstock, then juvenile fish may have been impinged on the screen during periods when all of the river flow was diverted into the penstock for power generation. In either case, significant mortality may have occurred.

Parkhurst (1950) gives detailed information on another dam, the De Ruwe Dam, which was located on the Tucannon River approximately 26 kilometers (16 miles) above the mouth. This dam was 1.5 meters (5.0 feet) high and was reported to block at least a portion of the chinook run above that point. The dam was originally constructed for power generation purposes between 1900 and 1910, but at the time of the survey in 1935, it only supplied water to an irrigation canal. A fish ladder was built on one end of the dam, but the surveyors reported that it was filled with mud and debris, overgrown with willows, and "entirely useless." They reported that, in summer months, splash boards were placed over the 3-meter (10-foot) spillway crest and that most of the river flow was diverted into an unscreened irrigation ditch.

For February 1935, Parkhurst (1950) accounted for 31 diversions withdrawing 3.6 cubic meters per second (128 cubic feet per second). Irrigation ditches, only three of which were screened, withdrew 2 cubic meters per second (72 cubic feet per second), and 1.6 cubic meters per second (56 cubic feet per second) were used to generate power (Parkhurst 1950). This volume of water is significant given that the season was winter.

In his narrative on the Tucannon River and Asotin Creek Dams, Parkhurst (1950) does not mention impacts to bull trout, or "Dolly Varden" as they were called at that time. He does, however, refer to significant impacts on salmon. Because chinook salmon, steelhead, and bull trout migrations into the Tucannon River overlap temporally today (Mendel, pers. comm., 2002d), impacts to fluvial bull trout may also have been high, especially since Starbuck Dam and De Ruwe Dam represented significant upstream and downstream migration barriers. Both dams operated in the same time period, and both were located well downstream of the upper watershed tributaries where bull trout currently spawn. The watershed area available to bull trout could have been reduced by as much as 90 percent for more than 40 years by the construction and operation of these two projects. And an even greater percentage of spawning habitat may have been eliminated because no tributaries enter the Tucannon River below this point.

Though the De Ruwe Dam no longer exists, the Starbuck Dam has been only partially removed. Potential continuing impacts to bull trout from the Starbuck Dam should be evaluated to determine the need for additional restoration measures.

Asotin Creek Core Area. The most significant impacts to bull trout in Asotin Creek associated with dam construction may have occurred historically when Headgate Dam and its water diversion works were constructed in the mainstem of Asotin Creek at river kilometer 14 (river mile 9) in 1906. The Washington Water Power Company of Spokane, Washington, is thought to have constructed the dam. The water diversion built at Headgate Dam replaced a crude ditch system that was dug in 1885 to carry water from Asotin Creek to Clarkston, Washington (ACMWP 1995). Below the dam, an additional water diversion ditch was built; this dam diverted more water from Asotin Creek to the City of Asotin, Washington. The exact volume of water that was diverted is not known, but it is believed to have been significant to supply enough water for domestic use in two rapidly growing towns. The dam itself was nearly 2 meters (6 feet) high and may or may not have included a fish ladder at the time of construction. One source reported that the dam included a ladder, but does not specifically relate the ladder to original construction. This report also describes the ladder as not adequately maintained (ACMWP 1995). Other accounts hold that no fish ladder was present at all until the early 1930's and that, even then, the ladder was poorly designed and not maintained (Mendel, pers. comm., 2002d).

In 1907, one year after original dam construction, a wooden penstock was constructed from Headgate Dam to a powerhouse containing a turbine and electrical generator more than 10 kilometers (6 miles) downstream. This power plant produced electricity for the towns of Asotin and Clarkston. Diversion of water into the penstock left the main Asotin Creek channel completely dry for more than 10 kilometers (6 miles) during the summer of most years and for even longer during dry years. Parkhurst (1950) noted that, for the 1935 survey, the penstock intake had been screened, but when the original screen was installed is unknown. For many years, bull trout, chinook salmon, and steelhead may have been unable to access the channel above the powerhouse. In high-water years, if enough water spilled over the dam in the spring, fish may have been able to jump or swim over the dam. Water velocities over the dam probably would have been excessive for smaller fish to be able to pass, but no information exists about passage conditions during spring runoff. Hydroelectric operations continued for 21 years at Headgate Dam until power generation ceased at the site in 1928; water continued to be diverted at two locations from the creek for domestic use in Asotin and Clarkston.

Before the early 1900's, spring chinook salmon were reported to be plentiful in Asotin Creek. In 1935, fish surveyors from the U.S. Bureau of Fisheries reported that 25 adult spring chinook salmon, and more than 250,000 juvenile steelhead, were trapped in a pool in the main Asotin Creek channel below the dam because the entire flow of the creek was diverted into the penstock and the municipal water diversions (ACMWP 1995). Although some water flow was returned to the main channel after 1928, fish passage across the dam was questionable. Water continued to be diverted from Headgate Dam to Clarkston Heights until 1964. By 1965, the small reservoir behind the dam was completely filled with rock and sediment. About the same time, the Washington Department of Game (now the Washington Department of Fish and Wildlife) and Asotin County worked to remove the top 46 centimeters (18 inches) of concrete from the center of the dam and to construct a "jumping pool" for fish below the dam (ACMWP 1995). The fish ladder at Headgate Dam was completely abandoned in 1970 after attempts to make it usable failed.

Today, fish passage at Headgate Dam is still a problem. More concrete has been removed from the center of the dam, but most of the dam is still intact. A significant volume of sediment and bedload material is still held behind the dam. Present fish passage (a V-notch in the dam) does not meet Washington State fish passage standards for adults and especially does not meet standards for juveniles (Mendel, pers. comm., 2002d).

After 1965, Headgate Dam became a popular site for anglers and day-use recreation because of the large, shallow pool above the dam. Early on, there were no facilities to accommodate the level of use the area received, resulting in serious impacts to the stream and streambanks. Adverse effects from this dam on bull trout populations probably occurred long ago from the severe decrease of in-stream flows and the resulting loss of any fluvial bull trout population that relied on the main creek channel to migrate. At the very minimum, at least four generations, and more realistically, 8 to 10 generations of adult bull trout, would have been unable to reach spawning areas in the upper watershed to reproduce.

The dam is now within Headgate State Park, a recreation area owned and operated by Asotin County. The pool above the dam, as well as the riparian area surrounding it, is still heavily used by recreationists throughout the spring, summer, and fall. The current fish passage limitations at Headgate Dam and the fact that the site is a high-use recreation area may limit future recovery efforts for bull trout in Asotin Creek, especially efforts to rebuild a fluvial bull trout population.

Parkhurst (1950) described the presence of another early dam (pre-1935) built by a former game commissioner at river kilometer 6 (river mile 4) on Asotin Creek. The dam was 0.6 meters (2 feet) high, apparently constructed to prevent bridgelip suckers (*Catastomus columbianus*) from migrating upstream in Asotin Creek. In 1935, fish surveyors felt that during low-flow periods, this dam would block salmon migration. It is unknown when the dam was built, how long it was in place, or how it was removed. The dam was not present in 1980 when the Washington Department of Game conducted habitat surveys in Asotin Creek (ACMWP 1995).

In 1948, the Washington Department of Game constructed two small earthen dams across the channel of Charley Creek approximately 6 kilometers (4 miles) above its confluence with Asotin Creek. The dams were built to create put-and-take rainbow trout (*O. mykiss*) ponds with a surface area of about 1.2 hectares (3.0 acres) and a maximum depth of about 5 meters (15 feet). The dams impeded upstream fish migration into Charley Creek for at least 16 years (WDFW 1997). In 1964, the dams and fishing ponds washed out during a large flood, sending sediment down Charley Creek and into Asotin Creek. For many years following, the stream channel in the area of the ponds was largely a steep, eroding gully with very little substrate or wood debris to produce water velocity breaks. Upstream fish movement from Asotin Creek is now possible even though the stream channel continues to head-cut where the ponds existed and overall passage conditions are poor. Despite numerous stabilization efforts at this site, it still produces elevated sediment loads that probably contribute to substrate embeddedness and channel widening issues in the mainstem of Asotin Creek.

Little information exists about whether Asotin Creek bull trout use the mainstem Snake River. Historical information from anglers who caught bull trout greater than 50 centimeters (20 inches) long from Asotin Creek suggests that large, fluvial bull trout were present in Asotin Creek and probably used the mainstem Snake River for foraging and overwintering to attain their size (Groat, pers. comm., 2002c). Other tributaries to the Snake River that enter both upstream and downstream of Asotin Creek are known to support fluvial bull trout, which have been observed using the mainstem of the Snake River. Construction of Lower Granite Dam on the lower Snake River, and of Hells Canyon Dam on the upper Snake River, probably did not confine Asotin Creek bull trout to an unproductive reach of the mainstem Snake River. Any Asotin Creek fish using the Snake River after Lower Granite Dam was completed and began operation in 1975 still had free access to 225 kilometers (140 miles) of the Snake River for foraging and overwintering. Information concerning the presence or status of fluvial bull trout from Asotin Creek, particularly on any use patterns of the mainstem Snake River, is not available.

Dam construction in the Snake River may have affected Asotin Creek bull trout to a lesser extent through conversion of river habitat to more reservoir-like habitat and through any negative impacts produced by changes in species composition and increased predator abundance. With regard to population size, the fluvial component of the Asotin Creek bull trout population may have been healthy, but inherently small, even before the smaller dams were built in Asotin Creek and migratory conditions in the lower reaches of this stream became impaired from habitat degradation. The Asotin Creek watershed is small, discharging only 2.1 cubic meters per second mean annual flow (74 cubic feet per second), while other Snake River tributaries discharge higher volumes of water and support modest numbers of fluvial fish (Stoval 2001). As human activities altered habitat in Asotin Creek, and lower stream reaches lost their ability to support rearing and migratory functions, fluvial bull trout would have been the first population component to disappear.

Some fluvial bull trout that currently use the Tucannon River and its tributaries are known to use the mainstem Snake River as foraging, migrating, and overwintering habitat. Also, fluvial bull trout in Asotin Creek and its tributaries historically used the mainstem Snake River as foraging, migrating, and overwintering habitat. For further information on the use of the mainstem Snake River by migratory bull trout, see Chapter 1.

Forest Management Practices

Timber harvest and associated activities such as road construction and skidding can increase sediment delivery to streams. This sediment delivery clogs substrate interstices and decreases stream channel stability and formation. Harvest in riparian areas decreases woody debris recruitment and negatively affects a stream's response to runoff patterns. Stream temperatures rise with decreases in the forest canopy and riparian zone shading. The timing and magnitude of runoff can also change, with more water delivered to streams in a shorter period causing increased stream energy and scour. Forest managers generally recognize these effects and design today's timber cuts to minimize such effects when possible. Although timber harvest comprises the third largest economic base in the Tucannon River watershed, most of the timber-related impacts that occur today in the Snake River Washington Recovery Unit are the result of historical timber harvest and road-building activities (legacy effects).

Tucannon River Core Area. The U.S. Forest Service manages the Umatilla National Forest, which contains 19,673 hectares (48,611 acres) of public land. Nearly 89 percent of all forested lands in the Tucannon River watershed are within the Umatilla National Forest boundary, including 4,856 hectares (12,000 acres) in the Wenaha-Tucannon Wilderness. An additional 2,002 hectares (4,948 acres) of forest lands owned by the Washington Department of Natural Resources are within the watershed. The Washington Department of Fish and Wildlife owns 5,276 hectares (13,037 acres) of mostly forested land outside the Umatilla National Forest.

In the Tucannon River watershed, the majority of current logging impacts are legacy effects from roads and harvest activities that occurred prior to the National Marine Fisheries Service listing of spring chinook salmon in 1992. Accounts of early logging on the Umatilla National Forest within the upper Tucannon River watershed state that the best saw logs had already been harvested by settlers and noncommercial loggers by 1905 (Kuttel 2002). Skidding operations were accomplished with horses, but stream and riparian damage occurred because logs were often moved downhill in stream channels and floodplains. Early harvest activities targeted only the most valuable trees. The bulk of commercial harvest began in the early 1950's. The U.S. Forest Service reported that approximately 30,352 hectares (75,000 acres) have been cut. Most of this land area has had harvest activity over the same areas more than once and by different harvest methods. Fifty to 75 percent of this acreage has been cut up to three times (USFS 1998a).

In the Tucannon River, the National Marine Fisheries Service and the U.S. Fish and Wildlife Service use the Equivalent Clearcut Acre Model as a management tool to assess watershed conditions. Within a watershed, this model determines an acceptable number of acres of forest stand in which the trees are predominantly less than 30 years old. This "threshold" percentage is determined by using total road-harvested acres and estimated forest recovery time and is intended to represent a harvest level under which a watershed can sustain acceptable erosion rates and ensure properly functioning fluvial processes. The threshold percentage determined by the National Marine Fisheries Service for the Tucannon River is 5.1 percent, with the Meadow Creek, the Little Tucannon River, and Cummins Creek drainages approaching 10 percent (USFS 1998a). For all timber sales, the U.S. Forest Service follows PACFISH (interim strategies for managing anadromous fish-producing watersheds in eastern Oregon and Washington, Idaho, and portions of California) (USDA and USDI 1995a) and INFISH (inland native fish interim strategy) (USDA and USDI 1995b) guidelines. By following these guidelines and excluding wetlands and riparian habitat conservation areas from harvest, the amount of harvestable land has been greatly reduced. From a total of 64,751 hectares (160,000 acres) of National Forest land outside the Wenaha-Tucannon Wilderness, only 16,997 hectares (42,000 acres) remain in which timber harvest can occur (USFS 1998a). The last logging operation that took place in what is now the Wenaha-Tucannon Wilderness occurred in 1978 along Panjab Creek above the Meadow Creek confluence. There is evidence of historical logging below the wilderness boundary, but no recent logging has occurred. All but the first 3 kilometers (2 miles) of Panjab Creek is in the wilderness.

The Tucannon River watershed has a total of 245 kilometers (152 miles) of roads within the Umatilla National Forest boundaries. There are 132 kilometers (82 miles) of road open year-round, while 113 kilometers (70 miles) are open only a portion of the year. Roads routinely run through riparian corridors along the river bottom because of the steep slopes of the canyon. Adverse legacy effects exist from some roads on National Forest land in the upper watershed because of original construction on very steep terrain. U.S. Forest Service Road 4712, built in the 1970's, is a main access road from Panjab Creek to the upper Tucannon River watershed above Sheep Creek. This road has a substantial, active landslide that delivers sediment directly into the Tucannon River from Panjab Creek. This reach of the mainstem Tucannon River is an important bull trout spawning location. U.S. Forest Service Road 4713, also built in the 1970's for a timber sale, is the primary access road into the Panjab Creek drainage. The road is slumping in several locations and delivers sediment to Panjab Creek, despite past cut-slope stabilization efforts by the U.S. Forest Service.

Asotin Creek Core Area. In a recent biological assessment, the U.S. Forest Service (1998b) described Federal activities on the Umatilla National Forest in the Asotin Creek watershed and their effects on bull trout local populations. In a description of the environmental baseline, the U.S. Forest Service described the status of bull trout in Asotin Creek with respect to population size, growth and survival, persistence, and genetic integrity. Both of the remaining local populations of bull trout in the Asotin Creek watershed exist in tributaries on U.S. Forest Service lands in the upper watershed. The apparent small size of the local populations is the primary concern for the U.S. Forest Service on forested lands in Asotin Creek.

The Umatilla National Forest encompasses 25,552 hectares (63,140 acres) in the Asotin Creek watershed. Only 40 percent of this area (10,221 hectares, or 25,256 acres) is forested. Nine percent of this amount is considered old-growth forest. Twenty-nine percent of the total Umatilla National Forest acreage is non-irrigated cropland, and 30 percent is rangeland. Both even-aged cuts (clear-cuts) and uneven-aged cuts (selective-cuts) are currently conducted in the basin.

In 1995, only about 162 hectares (400 acres) of old-growth timber remained, mostly in the North Fork Asotin Creek drainage and some in Charley Creek (F. Higgenbotham, U.S. Forest Service, pers. comm., 1995, cited in ACMWP 1995). Between 1970 and 1989, approximately 2,995 hectares (7,400 acres) of forest were clear-cut along tributaries to Asotin Creek, including Charley Creek, South Fork Asotin Creek, and two, 2-hectare (5-acre) cuts on both sides of Cougar Creek. The U.S. Forest Service indicated that these early cuts contributed to rises in water temperatures along adjacent streams because all riparian and upslope timber was harvested. Adequate riparian canopy has not regenerated along Cougar Creek where these two cuts occurred. Since 1970, selective-cuts in the Asotin Creek watershed accounted for 1,821 hectares (4,500 acres) of timber harvest. From 1990 to 1995, clear-cuts accounted for only 971 hectares (2,400 acres).

The U.S. Forest Service (1998b) used earlier studies by the Soil Conservation Service (1981) to report sediment delivery volume into Asotin Creek from land use activities in forests. More than 50 percent of the sediment delivered into Asotin Creek from timber-harvest activities came from existing roads. Some of the forested drainages in the Asotin Creek watershed have road densities as high as 2.6 to 5.0 kilometers of road per square kilometer (4.1 to 5.0 miles per square mile). Roads constructed in the 1970's and 1980's in Charley Creek, Cougar Creek, and South Fork Asotin Creek have been damaged by rain and snow runoff and exacerbated by inadequate drainage systems. Fill slopes on these roads are actively eroding and deliver sediment loads that eventually reach the mainstem of Asotin Creek.

After a 1974 flood, the Washington Department of Fish and Wildlife harvested considerable timber from their lands in the North Fork and South Fork of Asotin Creeks under a "salvage harvest." Although the harvest was designed to remove mostly dead or damaged timber, it also removed most of the live trees from riparian areas along sections of both tributaries (Mendel, pers. comm., 2002e). Legacy effects from this salvage operation in the North Fork and South Fork Asotin Creeks include active erosion, sediment delivery, and increased stream temperatures.

The U.S. Forest Service, as part of the Asotin Creek Technical Advisory Committee, listed the primary limiting factors to fish production as 1) high stream temperatures, even though stream temperatures are generally much cooler on National Forest lands than in privately held lands lower in the watershed; 2) low numbers of large pools; and (3) sediment deposition in spawning areas (ACMWP 1995). Even with these limiting factors, the U.S. Forest Service indicates that conditions on Umatilla National Forest lands in Asotin Creek are good to excellent for fish.

Below the National Forest boundary in Asotin Creek, the frequency of pool habitat and salmonid resting habitat is very limited (ACMWP 1995). Pool habitat in lower Asotin Creek is limited in part because sources of large woody debris (trees) have been eliminated by timber harvest on private property and because livestock have grazed riparian areas (ACMWP 1995).

Livestock Grazing

The most significant effect of livestock grazing in stream corridors is the removal or alteration of riparian vegetation and the physical destruction of streambanks. Other stream channel functions begin to break down when riparian vegetation is lost. Loss of bank vegetation significantly reduces bank stability and greatly increases erosion, bank retreat, and sediment delivery to streams during spring runoff. These effects combine to alter channel shape by increasing sediment buildup and reducing bed stability. Once the stream begins to lose hydraulic equilibrium, it begins to widen and channelize, resulting in loss of pool habitat and depth, in-stream fish cover, and habitat complexity. Grazing on pasture and rangeland is one of three predominant land uses within the Asotin Creek and Tucannon River watersheds. Historical and current grazing practices have caused riparian zone loss, channel widening and down-cutting, vertical cut banks, and excessive gully cuts in sections of both streams, especially Asotin Creek.

Tucannon River Core Area. Kuttel (2002) reports that since the late 1800’s, large herds of sheep and cattle were raised in the Blue Mountains and the upper Tucannon River watershed. The first community settled in the upper watershed in the 1860’s was a base camp for herders of cattle and sheep. In 1906, approximately 150 horses, 900 cattle, and 15,000 sheep grazed in the upper Tucannon River watershed. A map of the Wenaha National Forest dated 1908 documented several extensive cattle ranges and nine sheep ranges on forested land in the upper Tucannon River watershed (USFS 1998a). The National Forest boundaries have since been redrawn to encompass what is now the Umatilla National Forest. Grazed rangeland used for livestock production currently includes 36 percent of the Tucannon River watershed, covering 30,645 hectares (75,725 acres) (Gephart and Nordheim 2001).

The U.S. Forest Service (1998a) reported that some residents living in the watershed believe that current soil erosion problems on open hillsides, where no logging or road construction has occurred, are the result of extensive overgrazing by large sheep herds prior to 1950. Today, the Peola-Pomeroy allotment, which contains the Charley Creek-Pataha Unit, is the primary grazing allotment in the Tucannon River watershed.

Meadow Creek is an important bull trout spawning stream. The creek's lower end is part of the Upper Tucannon grazing allotment, which averages about 70 head of cattle (Kuttel 2002). The current impacts to Meadow Creek bull trout from livestock grazing in this allotment are unknown. Grazing is also a major land use in the Pataha Creek watershed; it is especially heavy in Pataha Creek below Columbia Center. The U.S. Forest Service (1992a revised) noted extensive grazing in one 4.0-kilometer (2.5-mile) section of Pataha Creek on National Forest land. Panjab Creek, another important bull trout spawning stream, was grazed before the Wenaha-Tucannon Wilderness was established. No livestock grazing has occurred in bull trout spawning areas since wilderness protection was implemented in Panjab Creek in the early 1950's.

In the Pataha Creek watershed, ranching comprises the second largest economic base (crop cultivation is the largest). Livestock grazing is a major land use; however, 60 of the 125 landowners who live in the watershed combine both grazing and cropland production on their property (PCD 1998). Rangeland occupies approximately 18,257 hectares (45,114 acres) of land in the Pataha Creek watershed, where grazing occurs largely on terrain either too steep or too dry to grow crops. The majority of grazed range is on the valley slopes above the river valley bottom; slope angles average 50 percent in these areas. In 1996, the condition of 69 percent of grazed lands in the watershed were rated from poor to fair, with soil loss from rill and sheet erosion on all rangeland estimated at 123 million kilograms (135,300 tons) per year (PCD 1998).

In 1991, the estimated annual sediment yield to the Snake River from grazed rangelands along the Tucannon River was 42.7 million kilograms (47,000 tons), or 15 percent of the total sediment load carried by the river that year (TRMWP 1997).

Asotin Creek Core Area. Effects of livestock grazing are listed as a primary limiting factor to aquatic habitat and salmonid production in Asotin Creek (USFS 1993a; ACMWP 1995; Kuttel 2002). Pastureland and associated riparian habitat along Asotin Creek are severely impacted by livestock in areas where animals are fenced in along the stream during the winter (NRCS 2001). These areas are described by the Natural Resources Conservation Service (NRCS 2001) as contributing negatively to the health of the watershed. The Natural Resources Conservation Service noted that, along the mainstem of Asotin Creek in 2000, only 16 percent of the channel had riparian canopy that met goals of at least 70 percent coverage. Riparian trees recently planted by the Asotin County Conservation District were not expected to provide shade for at least 15 years. In some locations, the stream has been used as a watering station for livestock for nearly a century. Although grazing practices and riparian fencing efforts have generally improved in the last seven years as a result of vigorous and proactive work by the Asotin County Conservation District, the damage in many stream reaches, particularly the mainstem below the National Forest boundary, will take years to repair. Damaged streambanks will continue to deliver sediment in many locations, and stream temperatures will remain high without shade from riparian cover. Except in headwater tributaries, these conditions are a common problem in Asotin Creek.

Denuded riparian zones are common in the mainstem of Asotin Creek, South Fork Asotin Creek, and Charley Creek. The lower 4.0 kilometers (2.5 miles) of Charley Creek are severely damaged as a result of cattle watering directly in the stream channel. The lack of riparian canopy cover greatly increases stream temperatures, especially in summer, in all of these streams. Poor riparian and streambank conditions exacerbated damage caused by large floods in 1964, 1974, and 1997, damage that further reduced riparian cover and significantly increased stream temperatures (Stoval 2001). In 1992, temperature monitoring data showed stream temperatures exceeded the Washington State standard from the confluence of the North Fork and South Fork Asotin Creeks at river kilometer 24 (river mile 15) all the way downstream to the mouth of Asotin Creek. High temperatures were believed to be caused by loss of riparian cover and corresponding lack of stream shade (Stovall 2001). A flood in February 1996 removed even more unstable vegetation that was already damaged from confined winter grazing adjacent to the stream.

In 1906, an estimated 30,000 sheep grazed in the Asotin Creek watershed. The U.S. Forest Service began regulating grazing on its lands and established the Asotin allotment in 1929 and the Peola-Pomeroy allotment in 1939 (Stoval 2001). Pasture and rangelands cover 43 percent (36,582 hectares, or 90,393 acres) of the entire Asotin Creek watershed. On Umatilla National Forest lands within Asotin Creek, 30 percent (7,666 hectares, or 18,942 acres) of a total of 25,552 hectares (63,140 acres) is open rangeland. Livestock winter mainly in the lower portions of the watershed from December through March and move upstream in the late spring and summer. Cattle herds continue to graze the lower slopes through the spring until National Forest lands are opened for grazing in June or July (Stoval 2001).

Currently, six private ranchers hold grazing permits on National Forest grazing allotments for a total of 4,500 animal unit months. Below the National Forest boundary on private rangelands adjacent to the stream, 30 percent of the streambank length is grazed year-around or between mid-summer and late winter. The other 70 percent of stream length is either fenced off permanently or grazed only during spring and early summer (ACMWP 1995). About 50 percent of the livestock using rangelands in the Asotin Creek watershed remain in the area year-round. Confined livestock feeding areas are present during winter months along the lower mainstem of Asotin Creek, Charley Creek, and South Fork Asotin Creek. Most of the livestock grazing in each watershed occurs in areas below the National Forest boundary line.

Agricultural Practices

Agriculture is an important part of the economic base for counties in both the Asotin Creek and Tucannon River watersheds. There are 142 farm and ranch operators who own or lease agricultural lands in the watershed (Stoval 2001). Of these farmers, 73 operate full time (ACMWP 1995). The size of agricultural land holdings ranges from 65 hectares (160 acres) to about 2,023 hectares (5,000 acres). The average land holding used for agriculture in the Asotin Creek watershed is 807 hectares (1,993 acres) (Stoval 2001). In the Tucannon River watershed, 83 full-time farm operators own or lease land parcels averaging of 567 hectares (1,400 acres) (TRMWP 1997). In 1997, average soil erosion rates in the Tucannon River watershed exceeded the soil productivity standards of the Natural Resources Conservation Service, and stream sedimentation exceeded tolerable levels for salmonid fish in some locations (TRMWP 1997).

Farming practices, especially those used in the early part of the century, produced high erosion rates and upland degradation (Gephart and Nordheim 2001). Most of the cropland in Asotin Creek and Tucannon River watersheds is classified as “highly erodible land” (ACMWP 1995; TRMWP 1997; Stovall 2001). More recently, farmers have adopted conservation practices such as direct seeding, strip cropping, and terracing to reduce erosion rates and sediment transport to streams. Despite these efforts, sediment delivery to streams from upland sources in both the Tucannon River and Asotin Creek watersheds is still a significant concern in protecting salmonid habitat (TRMWP 1997; Gephart and Nordheim 2001; Stovall 2001; Kuttel 2002).

Tucannon River Core Area. Agricultural practices on naturally erodible soil types, along with tilling and seeding immediately adjacent to and in the floodplain of the Tucannon River, have resulted in greatly increased coarse sediment loads and increased substrate embeddedness along the lower 32 kilometers (20 miles) of the river. The river’s width-to-depth ratio has increased significantly in the lower watershed. Along tilled areas of the streambanks, riparian vegetation has been removed to allow fields to drain more quickly and to reduce the propensity of flooding. Farming practices used from the early 1900’s to 1970 produced high erosion rates, sediment transport to streams, and overall degradation of habitat and water quality in some areas.

Crop systems in the Tucannon River watershed reflect the limited precipitation. Alfalfa, hay, and corn are raised in rotation on approximately 1,147 hectares (2,835 acres) of irrigated bottomlands along the Tucannon River (Gephart and Nordheim 2001). Despite upgraded soil conservation practices and increasing use of no-till crops, a Soil Conservation Service estimate in 1986 put total basin erosion rates at more than 964 million kilograms (1,060,000 tons) of soil per year (Gephart and Nordheim 2001). An estimated 162 million kilograms (177,600 tons) of sediment are deposited in streams within the watershed each year.

Pataha Creek is the largest tributary to the Tucannon River, with a mainstem stream length of more than 98 kilometers (60 miles). While Pataha Creek's mean annual flow has not been calculated, flow measurements ranged between 0.14 cubic meter per second (5 cubic feet per second) in September 1998 to 0.76 cubic meter per second (27 cubic feet per second) in March 1999. Agriculture is one of two primary land uses in this watershed. In Pataha Creek, from the Town of Dodge at river kilometer 16 (river mile 10) down to the stream's confluence with the Tucannon River, the channel is extensively incised as a result of ditching along farm fields and subsequent erosion. The stream has downcut through more than 6 meters (20 to 25 feet) of silt and clay to expose raw bedrock in many locations from the City of Pomeroy to the mouth of the creek. Erosion of cropland soil is exacerbated by the fact that nearly all livestock operators move cattle to cropland following harvest of fields to forage on leftover crop vegetation (PCD 1998). Cropland was identified as the major contributor of the more than 187 million kilograms (205,200 tons) of sediment lost each year through runoff in the mid 1980's. The Pataha Creek sediment load was identified as the primary cause of accelerated braiding in the lower reaches of the Tucannon River below the mouth of Pataha Creek (PCD 1998).

Elevated water temperatures in the lower Tucannon River are believed to be caused, in part, by reduced water volume from withdrawals for irrigation. Removal of water for irrigation is highest in dry years, when the Tucannon River is already low and needs to retain its flow volume to remain within tolerance levels for fish. Irrigation effects are most adverse in borderline water years when the snow pack is low and air temperatures are high. A cursory review of irrigation system data indicates that the overall efficiency of the irrigation system to use water that has been withdrawn is only 65 percent (TRMWP 1997). As of 1995, the Washington Department of Ecology had issued 68 surface water rights for the Tucannon River (Covert *et al.* 1995) for a total diversion of 1.7 cubic meters per second (60 cubic feet per second) to irrigate 464 hectares (1,147 acres) (TRMWP 1997). In 2000, only one additional water right application was pending, for 0.02 cubic meters per second (0.67 cubic feet per second). Since 1995, all other surface water right applications to the Washington Department of Ecology since 1995 have been denied.

Water removed from the Tucannon River during peak crop irrigation may cause a reduction in stream flow that could have adverse impacts on stream temperatures and bull trout migration. Impacts could be particularly severe during spring and fall migration periods in dry years with low snow pack runoff. In dry years, the base summer flows before any withdrawal are well below the volume allocated in combined irrigation permits. The compliance status for fish screen installation on all diversions is unknown. Similarly, it is not known whether diversions are screened in accordance with specifications of the U.S. Fish and Wildlife Service and National Marine Fisheries Service.

Asotin Creek Core Area. Crop production in the Asotin Creek watershed is the second largest land use in Asotin Creek, followed by livestock production. Approximately 26 percent (22,240 hectares, or 54,956 acres) of the watershed is comprised of cropland consisting of grasses, legumes, winter wheat, and spring barley (Stoval 2001). Nearly 6,645 hectares (16,420 acres) of cropland are enrolled in the Conservation Reserve Program. Summerfallow, an erosive till-crop method, occurred in one out of every three years up until 1997, when erosion estimates reached 8,985 kilograms per hectare per year (four tons per acre per year). Direct seeding has now replaced summerfallow practices (Stoval 2001). In discussing “major limiting factors,” the *Asotin Creek Subbasin Summary* (Stoval 2001) states that “Agriculture development has altered or destroyed vast amounts of native shrub steppe habitat, and fragmented riparian/floodplain habitat in the Asotin Creek subbasin. Agriculture operations have increased sediment loads and introduced herbicides and pesticides into streams.” In 1995, of the estimated 40 million kilograms (44,420 tons) of sediment delivered annually to Asotin Creek from all sources, the majority came from croplands (Stoval 2001), even though 30 percent of all agricultural lands in the watershed are enrolled in the Conservation Reserve Program. More than 50 percent of this sediment comes from agricultural and grazing practices in George and Pintler Creeks and from croplands adjacent to lower reaches of the mainstem of Asotin Creek (Stoval 2001). Loess soils predominate in this watershed and are highly susceptible to erosion with any kind of soil disturbance. Most of the sediment load delivered to Asotin Creek and its tributaries comes from upland agriculture below the National Forest boundary (Stoval 2001).

There are an unknown number of small irrigation diversions with unknown screen status on Asotin Creek. In 1950 during a fish survey for the U.S. Fish and Wildlife Service, Parkhurst (1950) counted all of the water diversions from Asotin Creek. By 1994, all of the 31 water diversions he identified were either abandoned or screened. It is not known whether all screens in the watershed meet U.S. Fish and Wildlife Service and National Marine Fisheries Service standards, and so they should be evaluated to verify that bull trout are not affected. Direct impacts to bull trout from water diversions are unknown.

Approximately 10 small pump diversions used to water lawns at private residences are believed to be present in the reach from George Creek to the mouth of Asotin Creek. There is no information on screening compliance (Kuttel 2002) or on impacts to bull trout from operations of the pumps.

<u>Transportation Networks</u>

Roads have been constructed in the Snake River Washington Recovery Unit to provide access for timber harvest, recreation, and urban development and for associated infrastructure, travel, and commerce. Sedimentation and stream channel changes are the primary negative effects of roads on streams (Furniss *et al.* 1991). Edwards and Burns (1986) linked levels of fine sediment in streams to road densities. Weaver and Fraley (1991) and Shepard *et al*. (1984) linked levels of fine sediment to ground-disturbing activities associated with road building. Roads constructed for timber harvest have been linked to significant increases in water yield and peak flows in forested basins (Troendle and King 1987). On steep or unstable slopes, poorly constructed or maintained roads can wash out and trigger large debris flows, which can fill streams with sediment and result in channel instability even decades after the road is abandoned (Cacek 1989).

Culverts are the most common migration barriers associated with road networks. Hydraulic characteristics within a culvert, and improper culvert placement, can impede or prevent fish passage. When Dunham and Rieman (1999) studied patch frequency and occurrence of bull trout in streams within the Boise River basin in Idaho, they found that the occurrence of bull trout was negatively related to road density in the stream basin. Road location and slope, construction methods, local geology, and hydraulic regimes may all affect the level of impact that roads have on bull trout habitat. Accessible roads along streams occupied by bull trout inevitably increase human access to the streams, access that may increase risk to local populations from angling mortality and introduction of nonnative salmonids (Furniss *et al*. 1991; Lee *et al.* 1997).

Tucannon River Core Area. The U.S. Forest Service reported that the Tucannon River watershed, excluding Pataha Creek, has 244 kilometers (152 miles) of road on National Forest lands (USFS 1998a). The *Tucannon River Watershed Biological Assessment of Ongoing Activities for Consultation on Bull Trout* (USFS 1998a) describes road density and road location on forest lands as “Functioning at Risk..” There are roads with riparian areas within occupied bull trout habitat on U.S. Forest Service lands in the upper watershed. As of 1994, the overall road density on forest lands in the Tucannon River watershed was slightly less than 1.2 kilometers per square kilometer (2.0 miles per square mile).

Within the Pataha Creek watershed, there are 341 kilometers (212 miles) of dirt, gravel, and paved County roads. An additional 240 kilometers of roads (149 miles) in the watershed are on the Umatilla National Forest. Many of the roads in this watershed run parallel to Pataha Creek and cross over many smaller tributaries. The road network in Pataha Creek watershed is largely a non-engineered system that is more than a century old. These roads receive runoff from adjacent lands and funnel sediment into Pataha Creek. Although some of the sediment delivered to Pataha Creek comes from poorly constructed and poorly maintained roads, it is important to note that much of the increased sediment delivered by the road system originates from upland land use activities. These activities create loose sediment, which is then deposited in road ditches and culverts that were not designed to transport elevated sediment inputs.

Water damage periodically occurs to roads in the floodplain. Subsequent road maintenance, especially on the main gravel road providing access up Pataha Creek, exacerbates sediment delivery because there are no sediment catch basins along the road and drainage ditches quickly fill with sediment (PCD 1998). In addition, some roads were built on excessively steep grades in the watershed and therefore deliver sediment during runoff and rainstorms. Many of these roads have steep, unprotected cut-and-embankment slopes that have moderate to severe tendencies to erode and therefore to move sediment into the stream system. Specific road maintenance activities that may have impacted historical populations of bull trout in Pataha Creek, and may impact any establishment of bull trout in this watershed, include undersized culverts incapable of handling high sediment loads, installation of flood control channel structures and riprap, ditch and roadway cleaning without sediment removal, grading of aggregate and unsurfaced roads, vegetation control, herbicide and dust-control chemicals, and winter road sanding. Road conditions along Pataha Creek not only affect stream conditions locally, but also impact channel conditions in the mainstem of the Tucannon River at its confluence with Pataha Creek.

Asotin Creek Core Area. Road development and maintenance activities have impacted riparian vegetation along Asotin Creek. Roads are located in the floodplain of most streams and have contributed to the loss of riparian canopies that maintain cool stream temperatures. The mainstem of Asotin Creek has been straightened in numerous places, diked, and even relocated in some reaches to protect the Asotin Creek Road. Asotin Creek Road is an improved-surface road (light paving) that provides the main access to the upper watershed. This road follows the creek bed for 24 kilometers (15 miles). In the upper watershed, between North Fork and South Fork Asotin Creeks, the Asotin Creek Road becomes a graveled, light-duty road maintained by the U.S. Forest Service. This road crosses the stream in numerous locations, requiring the use of culverts, each with variable impacts on fish passage. Many culverts in smaller tributaries need to be replaced to reduce the risk of road failure. A culvert under the Asotin County Road, which crosses Charley Creek, may be a fish passage barrier and needs to be investigated. A perched culvert at the Trent Ridge Road crossing and an associated in-channel pond may represent fish barriers on George Creek. Though George Creek was identified as a potential local population of bull trout by the Snake River Washington Recovery Unit Team, all barriers created by culverts should be addressed as up-front tasks before money is spent on habitat work in this watershed.

Most culverts in the watershed are sized to pass water produced by 25- to 50-year flood events. But many of these culverts are not adequately sized to pass both water and woody material during any large event. Road construction has resulted in loss of riparian vegetation along the mainstem of Asotin Creek, straightening of the stream channel, and significant loss of floodplain function. Most pool habitat has been lost, and not until recently has work been initiated to add log structures to create step pools and rebuild meanders in the stream channel.

Residential Development and Urbanization

Residential development within and adjacent to stream floodplains usually alters flow patterns and important floodplain functions. Stream channel alterations are common in developed areas because property owners attempt to protect property from high water. Urban development replaces important riparian corridors with concrete retaining walls or riprap to protect structures from natural flooding. In developed areas adjacent to a stream, the floodplain is often confined or restricted on one side, a situation that increases scour energy and erosion on the opposite side. Trees and vegetation cleared from streambanks result in significantly reduced bank stability as root masses die, decreased canopy shade, and reduction or elimination of large woody debris sources for the stream. Channel and riparian alterations are detrimental to fish habitat by reducing channel sinuosity, increasing erosive stream energy, and reducing habitat complexity.

Urban development increases demand for surface water for domestic and industrial purposes. Water from leaking septic tanks, drain fields, and storm runoff may seep into groundwater or flow directly into streams as surface flow, causing increased nutrient loads and negative changes in water chemistry and stream temperatures. Groundwater levels may be affected by construction of impermeable surfaces (parking lots, streets, and driveways) and withdrawals for drinking water. Groundwater percolation up into stream gravels is an important characteristic identified in some bull trout spawning areas (Heimer 1965; Shepard *et al*. 1984; Pratt and Huston 1993).

Tucannon River Core Area. As of 1997, the Tucannon River watershed had an estimated total population of 800 full-time residents, including 235 people who live in Starbuck, the principal community in the watershed. There are 83 permanent farm and ranch operators that own or lease agricultural lands in the watershed, and most of these operators own homes and large parcels of land up to 2,023 hectares (5,000 acres) in size (TRMWP 1997). Agriculture is the largest contributor to the economy, followed by forest products and recreation. A number of smaller homes are located mostly along the river corridor and are primarily used for recreational purposes rather than for full-time residences.

Although less than one percent of the land surface in the watershed is covered by urban development, expanding residential subdivisions, numerous individual homes, and the associated infrastructure are located primarily in floodplain areas of the mainstem Tucannon River. In addition, the road network is expanding to accommodate population growth in the watershed.

The Pataha Creek watershed comprises about 35 percent of the entire Tucannon River watershed land area. Private landownership is divided among 152 landowners. The City of Pomeroy is located along Pataha Creek, with City roads and infrastructure located in the floodplain. Within Pomeroy, significant portions of the streambank on both sides have been converted to vertical walls reinforced with concrete or riprap. The stream has been straightened, and there is no floodplain function in this reach. Large trees and other riparian vegetation are largely missing because of channel modification within the City limits and because of upstream land use activities that have caused severe head-cutting and erosion upstream of Pomeroy. In 1998, canopy cover in Pataha Creek ranged from 5 to 15 percent from Pomeroy downstream to its confluence with the Tucannon River (Kuttel 2002). Abandoned concrete slabs covered with mud and vegetation have blocked the stream channel downstream of the well site for Pomeroy.

Asotin Creek Core Area. The lower reaches of the mainstem of Asotin Creek are becoming increasingly urbanized (B. Johnson, Asotin County Conservation District, pers. comm., 2002). Residential development along the lower reaches of Asotin Creek was identified as a primary limiting factor in reestablishing a fluvial bull trout population in the creek and in expanding the downstream distribution of juvenile and subadult rearing habitat (Johnson, pers. comm., 2002; Mendel, pers. comm., 2002f). From the mouth of Asotin Creek upstream to George Creek, a distance of only 5 kilometers (3.1 miles), 55 homes are built in the floodplain, all within 94 meters (300 feet) of the creek channel. From George Creek to Headgate Park, a distance of 9.0 kilometers (5.6 miles), 11 more homes have been built in the floodplain. Above Headgate Park, at river kilometer 14.0 (river mile 8.7), 5 more homes are present in the floodplain within less than 2 kilometers (1 mile). Many of these residential lots contain a home with pasture and livestock feedlots.

Much of the stream channel along these residential areas is confined by riprap and dikes to protect property from floods. These flood control structures, bank protection measures, and heavy animal and human use of the streambanks have caused extensive damage to riparian cover, wood recruitment, pool habitat, and all stream attributes necessary for successful fish migration (ACMWP 1995; USFS 1998b). Stream temperatures during the summer from Headgate Park to the mouth of Asotin Creek are also elevated, at least in part as a result of the development, a factor that probably limits most mainstem use by salmonids in the late spring, summer, and fall.

Mining

Tucannon River Core Area. Mining historically occurred in isolated areas of the upper Tucannon River watershed. Mining development occurred between 1897 and 1998. At least four placer mines (Last Chance, Alice, Eureka, and Big Four) were operated during this period on Cummings Creek and the upper Tucannon River. The mines produced only small quantities of gold, silver, and copper ore. Most mining operations in the basin were abandoned around 1920 because they were not profitable (USFS 1998a). It is unknown whether these mines and their resulting waste materials affected water quality or habitat in the Tucannon River watershed. The U.S. Forest Service (1992b) did not identify any adverse conditions from two old mine sites on Cummings Creek.

Asotin Creek. No documentation of mining activities in the Asotin Creek watershed was found.

Fisheries Management

Historically, overharvest of bull trout throughout the Columbia River basin probably contributed to their decline. In the same period, reduction in spawning and rearing habitat in tributary systems lowered fish production. Harvest may have included both legal recreational angling and poaching. The bull trout’s piscivorous nature created negative public perception that these fish consumed large numbers of more desirable salmonids. As a result, bull trout were held in low regard by anglers and were targeted for removal (Simpson and Wallace 1982; Bond 1992). State-sponsored eradication programs and bounties were offered for removing bull trout in Montana (Thomas 1992); however, there is no written record of these types of programs occurring in Washington (Mendel, pers. comm., 2002g)

In recognition of bull trout declines, State management agencies in Idaho, Montana, Washington, and Oregon suspended harvest of bull trout in the Columbia River basin except in a few limited locations. State fishing regulations allow for the harvest of other salmonid species in most waters. As bull trout populations become small, every adult fish becomes increasingly important to the propagation of future generations. In the Snake River Washington Recovery Unit, every bull trout mortality caused by incidental hooking is significant. This source of mortality will always be present in streams occupied by both bull trout and other fishable stocks of anadromous or resident salmonids. The Tucannon River is used by Snake River steelhead, spring chinook, and fall chinook salmon; of the anadromous species, a fishery exists only for steelhead.

Within the Snake River Washington Recovery Unit, overfishing has reduced bull trout populations in some southeast Washington streams, including the Tucannon River, as some anglers targeted bull trout when the fish were concentrated below stream barriers and vulnerable just prior to, or during, spawning (Mendel, pers. comm., 2002g). In addition, bull trout may have been historically considered an unfavorable species by anglers, as occurred in other areas (Thomas 1992), and been specifically targeted for removal. Current angler-related threats to bull trout in the Snake River Washington Recovery Unit could occur through misidentification and accidental harvest, intentional poaching, or hooking mortality.

The lower Snake River dams converted free-flowing (lotic) river habitats into slow-moving (lentic) reservoir habitat. With this change also came new fish species assemblages that were introduced to exploit the changed habitat. Seventeen nonnative fish species currently share resources with 18 native species in the lower Snake River reservoirs (Bartels *et al.* 2001). While attempts to study bull trout interactions, or diet overlap, with nonnative fishes in the Snake River have not been completed, it is likely that some level of competition and or predation occurs that does not favor bull trout. Well documented is the fact that the number of nonsalmonid fish predators has increased since the lower Snake River reservoirs were created (Karchesky and Bennett 1995).

Tucannon River Core Area. Recreation activities in the Tucannon River watershed are not all linked with fishing; however, fishing is a primary attraction for people visiting the river. Eight manmade lakes have been constructed adjacent to the Tucannon River from the mouth of Cummings Creek to Panjab Creek, a distance of 19 kilometers (12 miles). Six of these lakes withdraw water from the Tucannon River at a rate of 0.07 cubic meters per second (2.5 cubic feet per second) each; two of the lakes are filled using spring water. These small lakes were made specifically for recreation: camping and rainbow trout fishing.

Rainbow Lake was built prior to 1980 just above Cummings Creek. A dam is used to divert water from the Tucannon River into the Tucannon Fish Hatchery and Rainbow Lake. The dam is enough of a barrier that it required a fish ladder. Though upstream passage efficiency for the early ladder was not evaluated, passage may have been limited because excessive slope in the ladder created high water velocities and because the step pools were small and infrequent. The Washington Department of Fish and Wildlife believes that passage for bull trout was poor. In 1994, the ladder was rebuilt, but bull trout were killed in the new ladder when they became caught by the gills in weir pickets that had spacing designed for larger steelhead and salmon (Mendel, pers. comm., 2002h). While the picket spacing has since been reduced to avoid this problem, the passage efficiency for bull trout at this site is still unknown and should be evaluated.

Curl Lake is another of these adjacent lakes that is used for acclimating spring chinook salmon. In 1996, the original dam, which diverted water into Curl Lake, and a fish ladder associated with the dam washed out, causing severe bank damage. The stream channel had to be reconstructed and the dam and fish ladder replaced. Passage at the original dam was thought to be poor. The dam now has a boulder-type fish ladder that is believed to afford good bull trout passage, but that ladder has not been evaluated. The dam currently diverts a volume of 0.14 cubic meter per second (5 cubic feet per second) into Curl Lake during summer and fall. The diversion is screened, but further reduces river flows in crucial low-flow periods each year.

The series of manmade lakes are located fairly high in the watershed, just downstream of Panjab Creek where bull trout spawn in the mainstem of the Tucannon River. The lakes attract heavy recreation pressure of all types. All of the lakes are open for trout fishing. Impacts that threaten bull trout occur as a result of recreational use, including poaching, incidental harvest, trampling of the streambank, and riparian clearing.

Many other recreation activities take place in or around the main river channel and tributaries. Poaching and streambank degradation caused by activities associated with fishing and camping have been identified as concerns for Tucannon River bull trout. Fishing, camping, hunting, wildlife viewing, and hiking constitute almost 400,000 visitor days per year. Recreation use is very high on forested lands and is the dominant use of lands within the Wenaha-Tucannon Wilderness. Recreation is also the primary activity on 39,536 hectares (16,000 acres) owned by the Washington Department of Fish and Wildlife adjacent to the Tucannon River. Because of the relatively narrow and steep stream canyons, most human activity takes place in riparian zones. In the Tucannon River watershed, more than 81 kilometers (50 miles) of trail are maintained for nonmotorized use, and 10 kilometers (6 miles) of trail are maintained for off-road recreational vehicles. Most trailheads originate at various locations along the river bottom.

In addition to managing eight lakes, the Washington Department of Fish and Wildlife currently manages seven campgrounds, averaging approximately 0.4 hectares (1.0 acre) in size, on State-owned lands in the watershed. Recreational activities are concentrated in the riparian zone, and substantial impacts have occurred to riparian soils and vegetation and to the stream channel. Vegetation is severely trampled or cut down, damaged by anglers attempting to access the stream, or removed by campers looking for firewood and roasting sticks. The stream channel and banks are devoid of large woody debris pieces because they have been removed for firewood, especially near campgrounds. On occasion, the river has also been temporarily dammed by people building rock structures for wading pools. Until recently, most campgrounds were located immediately adjacent to the river. In response to the Federal listing of spring chinook salmon that use the Tucannon River system, about half of the campgrounds were moved to protect damaged riparian zones, but some of the campgrounds still remain open in sensitive streamside locations.

The U.S. Forest Service owns five campgrounds located in areas adjacent to the Tucannon River, and a sixth is being considered (Gephart and Nordheim 2001). Recreation will probably always be an approved use in the watershed. But with greater human use comes an increased probability that bull trout will be impacted either directly through poaching or indirectly through damage to important migration corridors or spawning habitat. Focused programs to increase enforcement of fishing regulations and prudent management of camping facilities may be the only options to protect bull trout from recreation impacts.

The Tucannon River and its tributaries receive substantial fishing pressure all year, pressure that probably impacts adult bull trout spawning escapements. In 1990, Washington Department of Fish and Wildlife angling regulations allowed harvest of two bull trout per day, none smaller than 51 centimeters (20 inches). In 1996, to protect adult spawners, regulations were changed to eliminate bull trout harvest in the mainstem of the river and in all tributaries above and including Panjab Creek. In 1998, the bull trout limit was reduced to one fish over 61 centimeters (24 inches) below Panjab Creek. Bull trout harvest was allowed in the Tucannon River below Panjab Creek up until 1999, when the Washington Department of Fish and Wildlife closed the fishery. Benefits to the harvest closure have not been evaluated scientifically; however, since 1999, both the number and size of bull trout caught and released by steelhead anglers during the winter and spring is reported to have increased (Mendel, pers. comm., 2002i).

Although the bull trout fishery is closed, incidental hooking mortality still occurs while fishermen target other salmonid species during open fishing seasons (Mendel, pers. comm., 2002j). Snake River steelhead, spring chinook salmon, and fall chinook salmon all spawn in the Tucannon River. Managed salmonid fisheries are allowed for steelhead, resident rainbow trout, and mountain whitefish (*Prosopium williamsoni*) only. From 1983 through 1999, the Washington Department of Fish and Wildlife stocked rainbow trout into the Tucannon River near the Tucannon River Fish Hatchery. In this 17-year period, the Washington Department of Fish and Wildlife stocked 283,813 catchable rainbow trout. Significantly fewer rainbow trout were stocked in the 1990's to minimize potential impacts on listed steelhead and salmon, and stocking in the Tucannon River ceased completely in 2000. Impacts on bull trout from past stocking practices are unknown, but predation and competition for food may have occurred. Anglers can also harvest brook trout (*Salvelinus fontinalis*) with no limit in Pataha Creek, a Tucannon River tributary.

Steelhead are a popular game fish sought by Tucannon River anglers. The steelhead fishing season on the Tucannon River runs from September 1 to April 15. Total annual steelhead harvest ranges between 400 and 600 fish annually, with anglers expending an estimated 6,000 to 7,000 hours of fishing effort in this period. Barbless hooks (single or treble) are required for steelhead fishing, but bait (roe, shrimp, and night crawlers) is allowed and frequently used. Hooking mortality of adult bull trout is known to occur in the Tucannon River during spring steelhead fishing periods, but catch rates and mortality estimates have not been quantified (Mendel, pers. comm., 2002g). Beginning in 2002, as part of weekly steelhead creel surveys, the Washington Department of Fish and Wildlife queries all anglers to determine whether they have caught and released bull trout while fishing for steelhead. This information will be used to derive catch rates for estimates of adult bull trout abundance and provide rough estimates for bycatch hooking mortality (Mendel, pers. comm., 2002i).

In 1949, the Washington Department of Game built the Tucannon River Fish Hatchery to produce rainbow trout. Under an agreement in 1986, the U.S. Army Corps of Engineers purchased the hatchery to raise steelhead and spring chinook salmon as part of the Tucannon River anadromous fish supplementation program. Because bull trout evolved with native stocks of steelhead and salmon in this watershed, the recovery unit team does not believe that supplementation of these native stocks adversely impacts bull trout or acts to hinder bull trout recovery. Fall chinook salmon spawn naturally in the lower Tucannon River in the late fall. Deposited eggs from these fish may provide a valuable food source for post-spawn bull trout returning to the mainstem of the Tucannon River or the Snake River in November and December. Salmon and steelhead juveniles may represent important prey items for bull trout as salmonid smolt outmigration overlaps temporally and spatially with upstream migration of spawning bull trout in the spring. The hatchery steelhead fishery does, however, result in some level of additional bull trout hooking mortality (Mendel, pers. comm., 2002g).

Brook trout may have contributed to the extirpation of bull trout from the Pataha Creek local population. Hybridization between bull trout and brook trout has not been identified in the Tucannon River, and samples have not been collected for genetic evaluation. While brook trout pose a problem in Pataha Creek, they have not been found in any other tributaries to the Tucannon River and occur as the only known population in southeastern Washington (Mendel, pers. comm., 2002a). Brook trout are restricted to upper reaches of Pataha Creek because of severe stream channel degradation, riparian vegetation loss, and seasonally excessive water temperatures in the lower 64 kilometers (45 miles) of this stream.

Movement of brook trout from Pataha Creek into the Tucannon River is largely impeded or blocked completely because of habitat degradation in lower Pataha Creek. Kuttel (2002) reported that substrate in the lower 19 kilometers (12 miles) of Pataha Creek was 100 percent embedded and that substrate in all reaches from Pomeroy upstream to the National Forest boundary at river kilometer 69 (river mile 43) was more than 50 percent embedded with fine sediment. Brook trout encroachment into the Tucannon River may occur in the future under the right flow conditions, but, to date, such encroachment has not been documented (USFS 1998a).

Asotin Creek Core Area. Rainbow trout were heavily planted in Asotin Creek to support a recreational fishery. From 1935 to 1980, more than 1.2 million rainbow trout were stocked in Asotin Creek. In 1935, a planting record described rainbow trout stocking in South Fork Asotin Creek, Charley Creek, Lick Creek, and George Creek. It states that the streams were "heavily fished" and had good road access (stocking record shown in Appendix M of ACMWP 1995). As of April 1994, the Washington Department of Fish and Wildlife implemented regulations requiring barbless hooks and artificial lures only in Asotin Creek, but still allowed an eight-fish limit for rainbow trout in North Fork Asotin Creek. Bull trout harvest was closed in North Fork Asotin Creek above the National Forest boundary, but was allowed in the lower 8 kilometers (5 miles) of the stream. Bull trout harvest has since been completely closed in North Fork Asotin Creek, which is one of only two remaining areas where bull trout spawn in the Asotin Creek Core Area. Impacts to bull trout from more than 40 years of rainbow trout stocking and heavy fishing pressure are unknown.

As discussed earlier, fishing ponds were constructed in Charley Creek, a tributary of Asotin Creek, to provide fishing opportunities as early as 1949. There are no records that document adverse interactions between bull trout and hatchery rainbow trout in Asotin Creek. However, there are still severe habitat and sediment problems associated with erosion and head-cutting in Charley Creek where the fishing ponds previously existed in the stream channel.

Isolation and Habitat Fragmentation

Bull trout spawn and rear in isolated portions of stream drainages in both core areas of the Snake River Washington Recovery Unit. The locations of manmade barriers and the passage problems they cause have been well described. Some barriers have been eliminated, but some still exist as partial barriers with continuing impacts. Destruction of riparian zones, leading to high water temperatures, is the most significant factor acting to reduce fish movement and habitat use in the middle to lower reaches of the Tucannon River and Asotin Creek. Elevated water temperatures limit bull trout distribution in some areas from July through October. Juvenile rearing and adult migration in lower stream reaches is prevented during this period. Other water quality parameters within lower reaches of the Tucannon River watershed are within Washington State standards most of the time and probably do not hinder expansion of local populations.

Asotin Creek and the Tucannon River are separated by the mainstem hydroelectric facilities at Little Goose and Lower Granite Dams. While genetic analyses have not been initiated to provide conclusive evidence, the physical distance that separates these streams makes interbreeding unlikely between these populations. Additional genetic information is needed to verify the separation of bull trout within the core areas of the Snake River Washington Recovery Unit.

Tucannon River Core Area. Within the Tucannon River watershed, several important streams that support bull trout spawning and rearing have impassable natural barriers that substantially reduce the stream area available to fish. Most of these barriers are sizable waterfalls that may eliminate opportunities to bring additional stream area into production. Waterfall barriers, from 3 to 8 meters (10 to 25 feet) high occur in Sheep Creek at river kilometer 0.8 (river mile 0.5), in Bear Creek at river kilometer 4.8 (river mile 3.0), and in Cold Creek at river kilometer 3.2 (river mile 2.0). All three streams support spawning bull trout below these barriers. Habitat in each of the streams is protected by various Federal and State land designations. About 202 hectares (500 acres) in the Sheep Creek drainage are designated as a botanical preserve (USFS 1992d). The Bear Creek and Cold Creek drainages lie entirely within the Wenaha-Tucannon Wilderness (USFS 1992e, 1992f).

The Washington Department of Fish and Wildlife identified one structure that may hinder migration and access of bull trout to upper spawning reaches of the Tucannon River (Mendel, pers. comm., 2002h). Located below Rainbow Lake, this barrier is a fish weir that is used to capture adult chinook salmon. Bull trout are allowed to pass during noncollection periods by way of a fish ladder around the facility that was built in 1997. During fish collection periods, bull trout are allowed to pass twice daily as the weir is checked for salmon (USFS

1998a). No other information is available on how frequently bull trout use the ladder or on the ladder's passage efficiency.

Meadow Creek is another tributary that supports spawning bull trout. A survey in 1992 by the U.S. Forest Service survey (USFS 1992f) describes a log jam 3.6 meters (11.8 feet) high at river kilometer 0.5 (river mile 0.3). This log jam broke up during high spring flows in 1996, how long the log jam was there prior to 1996 is unknown. It may have blocked upstream migration. Kuttel (2002) describes numerous debris dam barriers caused by buildup of dense Russian thistle (*Salsola iberica*) combined with fine sediment. These barriers are reported to be adequately large and dense to block steelhead migration into Meadow Creek and may also inhibit movement of bull trout during certain periods of the year. The Washington Department of Fish and Wildlife has indicated that a woody riparian buffer zone along Meadow Creek is needed to trap most of the tumbleweed to keep it from reaching the stream (Kuttel 2002). Three natural waterfalls, each 0.6 meters (2.0 feet) high and lacking plunge pools, may also hinder bull trout movement during low-flow periods in Meadow Creek.

Asotin Creek Core Area. No waterfalls, dams, culverts, or irrigation diversions are present in North Fork Asotin Creek or Cougar Creek (USFS 1992b, 1992h). The only spawning populations of bull trout in the Asotin Creek watershed are found in upper North Fork Asotin Creek and Cougar Creek, one of North Fork Asotin Creek's upper tributaries. Both local populations are believed to be isolated resident fish because seasonal water temperatures and poor habitat conditions exclude bull trout use of the mainstem Asotin Creek below the confluence of Charley Creek at river kilometer 21.7 (river mile 13.5). Isolation of these bull trout is exacerbated because fluvial bull trout that used the Snake River are thought to be absent or in very low abundance. Poor conditions in the stream channel and riparian zones, as well as high substrate embeddedness, also limit bull trout distribution below Charley Creek in the mainstem of Asotin Creek.

ONGOING RECOVERY UNIT CONSERVATION MEASURES

Soil erosion and sediment delivery to streams. On private lands, the Asotin County Conservation District, Pomeroy Conservation District, Columbia Conservation District, and Natural Resources Conservation Service are currently working to encourage dryland farmers to implement best management practices that reduce soil erosion and sediment delivery to streams in the Tucannon River and Asotin Creek watersheds. Since 1995, numerous projects have been implemented in both watersheds, including using no-till/direct-seed farming methods, installing terraces and sediment basins, using vegetated filter strips, and enrolling crop acreage into the Conservation Reserve Program (Kuttel 2002). In the Asotin Creek watershed, more than 8,458 hectares (20,900 acres) of cropland were enrolled in the Conservation Reserve Program, and 41 hectares (102 acres) were converted to Conservation Reserve Enhancement Program buffers to reduce sediment delivery to stream drainages. In the Tucannon River watershed, the Columbia Conservation District was instrumental in converting 567 hectares (1,400 acres) of tilled cropland to no-till/direct-seed farming in 1999 and 2000. The Pomeroy Conservation District helped to establish 3,592 hectares (8,876 acres) of no-till/direct-seed farming and 357 hectares (883 acres) of beneficial strip cropping to reduce erosion from croplands in Pataha Creek. The Washington Department of Fish and Wildlife installed a sediment basin below Hardtack Grade to reduce sediment delivery to the Tucannon River from lands that it manages for the Washington Department of Natural Resources (Kuttel 2002). Projects such as these will be instrumental in restoring and protecting bull trout habitat in the Tucannon River.

Riparian Buffers. With key funding from the Bonneville Power Administration and the Washington State Salmon Recovery Funding Board, the Asotin County Conservation District (Asotin Creek watershed) and Columbia Conservation District (Tucannon River watershed) are addressing riparian zone problems through the Conservation Reserve Program. This program is intended to restore riparian forest buffers on agricultural land adjacent to salmonid-bearing streams (Kuttel 2002). The Conservation Reserve Program is available through the Natural Resources Conservation Service to landowners who want to restore riparian buffers. Livestock is fenced out of the buffer area, and native vegetation is replanted. Landowners are compensated at 200 percent of the agricultural value of the land placed in the buffer over a 10- to 15-year rental agreement. Since 1995, the Asotin County Conservation District, in cooperation with landowners, has replanted 9,144 linear meters (30,000 linear feet) of riparian vegetation and installed 8,229 linear meters (27,000 linear feet) of riparian fencing. Since 1996, the Columbia Conservation District has planted 196,826 riparian trees and shrubs and installed 6,325 meters (20,753 feet) of riparian fence along the Tucannon River.

The Asotin County Conservation District is currently improving 33 kilometers (20 miles) of riparian buffers along Asotin Creek and its tributaries. In the Tucannon River watershed, the Columbia Conservation District was instrumental in establishing more than 68 hectares (169 acres) of riparian buffer along the Tucannon River and its tributaries (Kuttel 2002). The Columbia County Conservation District is currently improving 40 kilometers (25 miles) of these buffer zones. In Pataha Creek from 1996 to 2000, the Pomeroy Conservation District planted 49,900 riparian trees, installed 2,743 meters (9,000 feet) of riparian fencing, and established 36 hectares (88 acres) of riparian buffer zone along streams (Kuttel 2002). These efforts will help to abate water temperature problems in stream corridors used by migrating bull trout and help to improve stability of streambanks in both the Asotin Creek and Tucannon River watersheds.

Instream habitat. Since 1995, the Asotin County Conservation District has also placed 327 in-stream habitat structures to create plunge and scour pool habitat in Asotin Creek (NRCS 2001). From 1996 to 2001 in the Tucannon River, the Columbia Conservation District installed structures to create 84 large pools and 615 small- to medium-size pools for fish habitat. In the same years, the Columbia Conservation District also placed large woody debris and various structures to improve habitat complexity along 9,072 meters (29,764 feet).

Fisheries management. All waters in the Tucannon River and Asotin Creek watersheds are closed to the harvest of bull trout. Open fishing areas do overlap with areas used by bull trout, but selective gear rules are in place to protect bull trout from injury if they are hooked incidentally. The Washington

Department of Fish and Wildlife no longer stocks hatchery trout in the Tucannon River or Asotin Creek; this practice may help to reduce potential competition with bull trout. To help stream productivity, the Washington Department of Fish and Wildlife returns carcasses of hatchery steelhead and salmon back to the Tucannon River. This practice may benefit growth and survival of juvenile and subadult bull trout. Each spring, the Washington Department of Fish and Wildlife also counts adult fluvial bull trout at the anadromous fish trap at the Tucannon River Hatchery. This information provides an index of adult bull trout escapement in the Tucannon River watershed, and, as bull trout recovery tasks are implemented, the counts will be valuable to assess population responses of this bull trout life history form.

The U.S. Fish and Wildlife Service and the Washington Department of Fish and Wildlife will cooperatively conduct a study to evaluate bull trout movements in the Tucannon River and lower Snake River. The proposed project will meet the requirements of reasonable and prudent measures (10.A.3.1) in the U.S. Fish and Wildlife Service's Biological Opinion for the Federal Columbia River Power System (USFWS 2000). This study will determine the spatial distribution, migration timing, and movements of adult migratory bull trout in the lower Tucannon River and Snake River. This study will also collect empirical data to determine whether fishway design at the Snake River dams are suitable for passing bull trout through the projects, and, if so, what features could be replicated at other projects. The project will also collect data on the spatial and temporal distribution of bull trout in the mainstem lower Snake River reservoirs, estimate "fall back," and determine whether bull trout losses result when fish leave the Lower Monumental Dam pool.

The State of Washington produced a draft plan called *Extinction Is Not an Option: A Statewide Strategy to Recover Salmon* (State of Washington 1999). The plan was produced by the Washington Governor's Salmon Recovery Office and Joint Natural Resources Cabinet and served as the template for recovery unit designation in the Washington portion of the Columbia River distinct population segment. While this plan focuses primarily on salmon, many of the same factors affecting salmon also impact bull trout. Therefore, overall goals and strategies identified in this document for restoring healthy populations of salmon are consistent with actions needed for bull trout recovery. In addition, recovery unit teams incorporated information from the Washington State salmonid stock inventory for bull trout/Dolly Varden (WDFW 1997) and the management plan for bull trout/Dolly Varden (WDFW 2000), both prepared by the Washington Department of Fish and Wildlife.

The Washington State legislature established the Watershed Management Act (ESHB 2514) and the Salmon Recovery Planning Act (ESHB 2496) to assist in salmon recovery efforts. The Watershed Management Act provides funding and a planning framework for locally based watershed management addressing water quality and quantity. The Salmon Recovery Planning Act provides the direction for developing analyses of limiting factors for salmon habitat and creates a list of prioritized restoration projects at the watershed level. The Washington State Conservation Commission developed an analysis of salmonid-limiting factors, addressing habitat factors affecting Snake River salmon, steelhead, and bull trout (Kuttel 202). Results of this work were applied in the recovery planning process for the Columbia River distinct population segment. Though not specifically targeting limiting factors for bull trout, these documents have nonetheless played an important role in developing the Snake River Washington Recovery Unit chapter.

STRATEGY FOR RECOVERY

A core area represents the closest approximation of a biologically functioning unit for bull trout. The combination of core habitat (*i.e.*, habitat that could supply all the necessary elements for the long-term security of bull trout, including for both spawning and rearing, as well as for foraging, migrating, and overwintering) and a core population (*i.e.*, bull trout inhabiting a core habitat) constitutes the basic core area on which to gauge recovery within a recovery unit. Within a core area, many local populations may exist.

The Snake River Washington Recovery Unit Team has identified priority streams within each core area (Appendices A and B) that either currently supply habitat elements necessary for long-term security or have a reasonable potential to be restored and supply elements for the long-term security of bull trout. Using the criteria below and professional judgment, the Snake River Washington Recovery Unit Team identified priority streams to focus the implementation of recovery activities to areas having the greatest potential to support bull trout. These priority streams include 1) known bull trout spawning streams; 2) streams that have evidence of bull trout recruitment and early life stage rearing; and 3) streams with habitat that may potentially support some level of recruitment, or local populations, since current habitat conditions have elements necessary for bull trout occupancy. Selected priority streams are considered the best of the best-remaining habitat for bull trout.

While there are many streams in both core areas that do not conform to the criteria established by the Snake River Washington Recovery Unit Team at this time, the recovery unit team recognizes that other streams in the core areas may provide elements necessary for self-sustaining local populations and will be included in recovery efforts if deemed appropriate in the future. The Snake River Washington Recovery Unit Team also acknowledges that there are stream segments that have not been identified as priorities for the reestablishment of local populations, but that they provide necessary components to the long-term security of a local population.

Factors for selecting priority streams that either currently or may potentially support local populations in the Snake River Washington Recovery Unit include the following:

1. Current or historic distribution
2. Sightings within the last 10 years
3. Water temperatures
4. Amount of public versus private land
5. Current habitat conditions
6. Restoration potential/"quick fix"
7. Poaching threats/accessibility
8. Exotic fish species presence/absence

Assessment of these factors was also used to prioritize streams and local populations (Appendices C and D) within the Snake River Washington Recovery Unit and may be used during recovery task implementation by management agencies to determine which streams will be the first for restoration and recovery activities

Pataha Creek and Hixon Creek have been identified as priority streams in the Tucannon River Core Area and are considered essential to the recovery of potential local populations of bull trout. Pataha Creek contained bull trout historically (Groat, pers. comm., 2002a). Hixon Creek is a priority stream because it contains habitat that may support bull trout. Both Pataha Creek and Hixon Creek may contain habitat that is essential to expand the distribution and abundance of bull trout.

George Creek, Coombs Creek, Hefflefinger Creek, and lower Wormell Gulch Creek have been identified as priority streams in the Asotin Creek Core Area and are considered essential to the recovery of potential local populations of bull trout. While bull trout have not been identified in these streams, the streams are identified as priority streams because they, at least in part, contain habitat that is suitable for bull trout. They, therefore, may need habitat restoration and protection to help increase bull trout distribution and abundance in the Asotin Creek Core Area.

The Snake River Washington Recovery Unit Team has identified the mainstem reaches of the Tucannon River and Asotin Creek as priority water bodies or core habitat. These reaches may serve as important migratory corridors and as overwintering, foraging, and rearing areas for juvenile, subadult, and adult bull trout. The recovery unit team believes that if habitat in the mainstem of Asotin Creek is currently degraded to the extent that it will not support migration by adult bull trout, restoration of the migratory corridor is critical to expand the number of local populations and to increase the likelihood that local populations spawning in headwater areas persist in the long term.

Recovery Goals and Objectives

The goal of the bull trout recovery plan is to **ensure the long-term persistence of self-sustaining, complex interacting groups of bull trout distributed throughout the species' native range, so that the species can be delisted**. To achieve this goal, the following objectives have been identified for bull trout in the Snake River Washington Recovery Unit:

- Maintain the current distribution of bull trout and restore distribution in previously occupied areas within the Snake River Washington Recovery Unit.

- Maintain stable or increasing trends in bull trout abundance.

- Restore and maintain suitable habitat conditions for all life history stages and forms.

- Conserve genetic diversity and provide opportunity for genetic exchange.

Rieman and McIntyre (1993) and Rieman and Allendorf (2001) evaluated the bull trout population numbers and habitat thresholds necessary for long-term viability of the species. They identified four elements, and the characteristics of those elements, to consider when evaluating the viability of bull trout populations. These four elements are (1) number of local populations; (2) adult abundance (defined as the number of spawning fish present in a core area in a given year); (3) productivity, or the reproductive rate of the population (as measured by population trend and variability); and (4) connectivity (as represented by the migratory life history form and functional habitat). For each element, the Snake River Washington Recovery Unit Team classified bull trout into relative risk categories based on the best available data and the professional judgment of the team.

The Snake River Washington Recovery Unit Team also evaluated each element under a potential recovered condition to produce recovery criteria. Evaluation of these elements under a recovered condition assumed that actions identified within this chapter had been implemented. Recovery criteria for the Snake River Washington Recovery Unit reflect (1) the stated objectives for the recovery unit, (2) evaluation of each population element in both current and recovered conditions, and (3) consideration of current and recovered habitat characteristics within the recovery unit. Recovery criteria will probably be revised in the future as more detailed information on bull trout population dynamics becomes available. Given the limited information on bull trout, both the level of adult abundance and the number of local populations needed to lessen the risk of extinction should be viewed as a best estimate.

This approach to developing recovery criteria acknowledges that the status of populations in some core areas may remain short of ideals described by conservation biology theory. Some core areas may be limited by natural attributes or by patch size and may always remain at a relatively high risk of extinction. Because of limited data within the Snake River Washington Recovery Unit, the recovery unit team relied heavily on the professional judgment of its members.

Local Populations. Metapopulation theory is an important consideration in bull trout recovery. A metapopulation is an interacting network of local populations with varying frequencies of migration and gene flow among them (Meffe and Carroll 1994) (see Chapter 1). Multiple local populations distributed and interconnected throughout a watershed provide a mechanism for spreading risk from stochastic events. In part, distribution of local populations in such a manner is an indicator of a functioning core area. Based in part on guidance from Rieman and McIntyre (1993), bull trout core areas with fewer than 5 local populations are at increased risk, core areas with between 5 and 10 local populations are at intermediate risk, and core areas with more than 10 interconnected local populations are at diminished risk.

For the Tucannon River Core Area, there are currently eight known local populations; for the Asotin Creek Core Area, there are two known local populations. Using the above guidance, the Snake River Washington Recovery Unit Team believes that bull trout in the Tucannon River Core Area are at intermediate risk, while those of the Asotin Creek Core Area are at increasing risk.

Adult Abundance. The recovered abundance levels in the Snake River Washington Recovery Unit were evaluated by considering theoretical estimates of effective population size, historical census information, and the professional judgment of recovery team members. In general, effective population size is a theoretical concept that allows us to predict potential future losses of genetic variation within a population due to small population sizes and genetic drift (see Chapter 1). For the purpose of recovery planning, effective population size is the number of adult bull trout that successfully spawn annually. Based on standardized theoretical equations (Crow and Kimura 1970), guidelines have been established for maintaining minimum effective population sizes for conservation purposes. Effective population sizes of greater than 50 adults are necessary to prevent inbreeding depression and a potential decrease in viability or reproductive fitness of a population (Franklin 1980). To minimize the loss of genetic variation due to genetic drift and maintain constant genetic variance within a population, an effective population size of at least 500 is recommended (Franklin 1980; Soule 1980; Lande 1988). Effective population sizes required to maintain long-term genetic variation that can serve as a reservoir for future adaptations in response to natural selection and changing environmental conditions are discussed in Chapter 1 of the recovery plan.

For bull trout, Rieman and Allendorf (2001) estimated that a minimum number of 50 to 100 spawners per year is needed to minimize potential inbreeding effects within local populations. In addition, a population size of between 500 and

1,000 adults in a core area is needed to minimize the deleterious effects of genetic variation from drift.

For the purposes of bull trout recovery planning, abundance levels were conservatively evaluated at the local population and core area levels. Local populations containing fewer than 100 spawning adults per year were classified as at risk from inbreeding depression. Bull trout core areas containing fewer than 1,000 spawning adults per year were classified as at risk from genetic drift.

Adult abundance in the Tucannon River Core Area was estimated (based on redd counts) at 600 to 700 adult spawners per year in the eight known local populations. Adult abundance in the Asotin Creek Core Area was estimated at less than 300 individuals in two known local populations, based on the results of bull trout surveys. Based on the guidance on abundance described above, bull trout in the Tucannon River Core Area were considered at intermediate risk of

inbreeding depression; bull trout in the Asotin Creek Core Area were considered at an increasing risk of inbreeding depression.

Productivity. A stable or increasing population is a key criterion for recovery under the requirements of the Endangered Species Act. Measures of the trend of a population (the tendency to increase, decrease, or remain stable) include population growth rate or productivity. Estimates of population growth rate (*i.e.*, productivity over the entire life cycle) that indicate a population is consistently failing to replace itself indicate increased extinction risk. Therefore, the reproductive rate should indicate that the population is replacing itself, or growing.

Since estimates of the total population size are rarely available, the productivity or population growth rate is usually estimated from temporal trends in indices of abundance at a particular life stage. For example, redd counts are often used as an index of a spawning adult population. The direction and magnitude of a trend in the index can be used as a surrogate for the growth rate of the entire population. For instance, a downward trend in an abundance indicator may signal the need for increased protection, regardless of the actual size of the population. A population that is below recovered abundance levels but moving toward recovery would be expected to exhibit an increasing trend in the indicator.

The population growth rate is an indicator of extinction probability. The probability of going extinct cannot be measured directly; it can, however, be estimated as the consequence of the population growth rate and the variability in that rate. For a population to be considered viable, its natural productivity should be sufficient for the population to replace itself from generation to generation. Evaluations of population status will also have to take into account uncertainty in estimates of population growth rate or productivity. The growth rate must indicate a stable or increasing population for a period of time for the population to contribute to recovery.

Because of the depressed and probably declining population trend and the loss of range within the basin, bull trout in the Asotin Creek Core Area are currently at increased risk. The Tucannon River Core Area is considered at intermediate risk because of an apparent population trend that is not declining and that has low to moderate annual variability.

Connectivity. The presence of the migratory life history form within the Snake River Washington Recovery Unit was used as an indicator of the functional connectivity of the recovery unit and both core areas. If the migratory life form was absent, or if the migratory form was present but local populations lacked connectivity, the core area was considered to be at increased risk. If the migratory life form persisted in at least some local populations, with partial ability to connect with other local populations, the core area was judged to be at intermediate risk. Or, if the migratory life form was present in all or nearly all local populations and had the ability to connect with other local populations, the core area was considered to be at diminished risk.

Migratory bull trout may persist in some local populations in the Tucannon River Core Area and, therefore, are considered to be at intermediate risk. Migratory forms in the Asotin Creek Core Area are believed to be absent or extremely limited in both local populations and are considered to be at increasing risk.

<u>Recovery Criteria</u>

Recovery criteria for bull trout in the Snake River Washington Recovery Unit are the following:

1. **Distribution criteria will be met when the total number of stable local populations has increased to 10 in the Tucannon River Core Area and 7 in the Asotin Creek Core Area.** These local populations must occur in separate streams with broad distribution throughout each core area.

2. **Trend criteria will be met when the overall bull trout population in the Snake River Washington Recovery Unit is accepted, under contemporary standards of the time, as stable or increasing, based on at least 10 years of spawning survey data.**

3. **Abundance criteria will be met when the Tucannon River Core Area supports an average of 1,000 adult bull trout annually and when the Asotin Creek Core Area supports an average of 700 adult bull trout annually.**

4. **Connectivity criteria will be met when migratory forms are present in all local populations and when intact migratory corridors among all local populations in both core areas provide an opportunity for genetic exchange and diversity.**

Recovery criteria for the Snake River Washington Recovery Unit were established to assess whether recovery actions are resulting in the recovery of bull trout. The Snake River Washington Recovery Unit Team expects that the recovery process will be dynamic and will be refined as more information becomes available. While removal of bull trout as a listed species under the Endangered Species Act (*i.e.*, delisting) can only occur for the entity that was listed (Columbia River distinct population segment), the criteria listed above will be used to determine when the

Snake River Washington Recovery Unit is fully contributing to recovery of the population segment.

Research Needs

Using the best scientific information available, the Snake River Washington Recovery Unit Team has described recovery criteria and recovery actions that are necessary to recover bull trout in the Snake River Washington Recovery Unit. However, the recovery unit team recognizes that many uncertainties exist regarding bull trout population abundance, distribution, and limiting factors and regarding actions needed to recover bull trout in the Snake River Washington Recovery Unit. Therefore, to implement effective management goals and recovery tasks within the Snake River Washington Recovery Unit, this recovery chapter will remain a flexible "working" document that uses new information as it becomes available. As part of this adaptive management approach, the Snake River Washington Recovery Unit Team has identified the need to initiate studies on bull trout habitat, genetics, abundance, and distribution in both core areas of the Snake River Washington Recovery Unit. Detailed feasibility studies may also be necessary to evaluate major habitat reconstruction projects and an artificial propagation program.

A primary research need is a complete understanding of the role that the mainstem Snake River should play in the recovery of bull trout. Fluvial bull trout probably comprised a strong component of local populations throughout the Snake River Washington Recovery Unit, including the areas in which bull trout are believed extirpated or persist in core populations with very low densities, such as in Asotin Creek. An important initial goal for the Snake River Washington Recovery Unit is to determine the current distribution and abundance of bull trout within each core area. The application of a scientifically accepted protocol such as that described in the draft *Protocol for Determining Bull Trout Presence* (Peterson *et al*. 2001), which is currently being evaluated by the Western Division of the American Fisheries Society, is recommended for this task. The American Fisheries Society protocol consists of standardized and statistically rigorous methods for determining the distribution of bull trout. Many other scientifically accepted guidance protocols are available and may be considered. The Washington Department of Fish and Wildlife has a State-developed guide by Bonar *et al.* (1997) for sampling the distribution and abundance of bull trout. Applying such a protocol will improve the ability of the Snake River Washington Recovery Unit Team and various resource agencies to identify the extent and strength of local populations in each core area. A standardized protocol will also provide a solid basis for revising local and core population classifications and for making prudent decisions about recovery strategies.

Specifically, tributaries that have had isolated or anecdotal reports of bull trout capture should be targeted to verify bull trout distribution. In both core areas, there is an urgent need to develop and implement a standardized monitoring and assessment protocol for bull trout spawning surveys and for juvenile recruitment estimates. Such monitoring and assessment protocols are also crucial to monitor the effectiveness of recovery actions. And developing and applying methods to assess population trends and extinction risk are necessary to provide data and to refine recovery criteria throughout the recovery process.

To ensure that restoration activities to recover bull trout include a focus on the critical limiting factors, survival rates for each bull trout age class must be assessed. Currently, we do not fully understand the relative contributions to bull trout decline of each limiting factor related to the mainstem Snake River environment, stream conditions, and migratory corridors. Significant data gaps exist for each of these habitat areas in the Snake River Washington Recovery Unit. The recovery unit team has placed high priorities on investigating specific habitat-limiting factors and key population attributes to ensure that future restoration projects are well focused and provide maximum benefits toward bull trout recovery. Examples of these studies include radio-tracking bull trout to assess movements, habitat use, juvenile rearing, and survival and identifying water temperature limitations in migration corridors.

Throughout the Snake River Washington Recovery Unit, efforts should be made to evaluate and identify (via feasibility study) which unoccupied tributaries have the greatest potential to support bull trout in the future. This work would evaluate stream habitat characteristics such as water temperature, groundwater influence, substrate size and movement, bed and bank stability, pool frequency, and large woody debris. This information can then be used to prioritize restoration efforts and to identify steams where artificial introduction or reintroduction may be feasible to expedite recovery.

The Role of Artificial Propagation and Transplantation

As described in Chapter 1, section 3(3) of the Endangered Species Act lists artificial propagation and transplantation as methods that may be used for the conservation of listed species. While artificial propagation has played an important role in the recovery of other listed fish species, the overall recovery strategy for bull trout in the Snake River Washington Recovery Unit, where possible, will emphasize identifying and correcting threats affecting bull trout and bull trout habitats. If artificial propagation is determined to be necessary for bull trout recovery within the Snake River Washington Recovery Unit and if a feasibility study identifies streams capable of supporting bull trout, the joint policy of the U.S. Fish and Wildlife Service and the National Marine Fisheries Service regarding controlled propagation of listed species will be followed (65 FR 56916).

Also, an appropriate plan would need to be approved to consider the effects of transplantation on other species as well as on the donor bull trout populations. Transplanting listed species must be authorized by the U.S. Fish and Wildlife Service through a 10(a)(1)(A) recovery permit, and methods must meet applicable State fish-handling and disease policies.

In numerous streams within the Asotin Creek Core Area (Charley, George, Coombs, Hefflefinger, lower Wormell Gulch, and South Fork Asotin Creeks) and in several streams within the Tucannon River Core Area (Pataha and Hixon Creeks and the Little Tucannon River), bull trout may or may not be present in habitat that historically contained reproducing populations. These streams are considered candidate locations for artificial propagation or transplantation activities.

Though every effort should be made to recover a species in the wild before implementing a controlled propagation program, there are a limited number of bull trout in the Asotin Creek Core Area. Natural recolonization is probably not a viable solution for enhancing the existing abundance and distribution of bull trout in this core area. Although bull trout in Asotin Creek may respond to habitat improvements in occupied and unoccupied streams, successful recovery will probably require an artificial propagation or transplant program.

Recent behavioral and genetic studies of bull trout support artificial propagation programs. These studies report that bull trout exhibit a high degree of fidelity to natal streams (James *et al.*, *in litt.*, 1998; Spruell *et al.* 2000; Hvenegaard and Thera 2001). Strong fidelity for natal streams does not mean that fish movement between adjacent populations or adjacent basins does not occur, but such fidelity may mean that gene flow and colonization or recolonization of unoccupied habitat may take more than several generations. Therefore, to achieve recovery in the time frame specified in Chapter 1 and this Snake River Washington Recovery Unit chapter, some form of artificial propagation or transplanting may be necessary. If the current Asotin Creek bull trout populations have been isolated and functioning at low abundance for a long period of time, such a program may be necessary to immediately increase the number of individual fish in the core area and to infuse new genetic material into existing populations to avoid loss of alleles and heterozygosity (Spruell *et al*. 1999). Before implementation of any artificial propagation or transplantation program, a feasibility study would be completed to identify streams with the greatest potential to support local populations of bull trout and to identify the best available source of genetic material.

The Snake River Washington Recovery Unit Team also considered the findings of the Montana Bull Trout Scientific Group (MBTSG 1996). This group concluded that hatcheries are one of many potential tools that could be used in bull trout recovery and that hatcheries are appropriate for establishing genetic reserves for declining populations and for some research strategies (MBTSG 1996). The Montana Bull Trout Scientific Group identified seven strategies that use artificially propagated fish and evaluated these strategies in relation to recovery criteria and objectives. The group provided recommendations and further concluded that transplants into areas where bull trout have been extirpated should be considered only after the causes of extirpation are identified and corrected.

The Snake River Washington Recovery Unit Team recommends the following: (1) identify and correct threats in the Tucannon River and Asotin Creek Core Areas to increase bull trout densities and allow natural population expansion to occur within streams that have evidence of recruitment; (2) consider an artificial propagation program within each of the core areas only if a feasibility study indicates that such a program is the best option for recovery or to establish a genetic reserve; and (3) recognize that, even if threats are identified and corrected in the Asotin Creek Core Area, natural recolonization of bull trout in streams that once supported a local population may take an extended amount of time. In this case, supplementation or transplantation may be the best option. For this option, a feasibility study would be completed to identify streams with the greatest potential to support local populations. Supplementation or transplanting would then occur concurrently with other restoration and recovery activities.

Estimated Date of Recovery

Expected time periods necessary to achieve recovery will vary among recovery units due to differences in bull trout status, factors affecting bull trout, implementation and effectiveness of recovery tasks, and population responses to recovery tasks. At a minimum, four to five bull trout generations (20 to 25 years) are expected to pass before all of the highest priority recovery tasks are completed and bull trout populations respond at levels necessary to achieve recovery in the Snake River Washington Recovery Unit.

For the Tucannon River Core Area, a minimum of four to five bull trout generations (20 to 25 years) will probably pass before high-priority recovery actions can significantly reduce identified threats to bull trout and populations exhibit positive, recovery level responses. However, the recovery unit team expects local population trends (*i.e.*, redd counts) to increase concurrently, or with minimal time lag, following implementation of recovery activities. Recovery criteria should be met within four to five generations (20 to 25 years).

For the Asotin Creek Core Area, two scenarios for the estimated time frame needed for bull trout recovery were considered:

1. Promote natural recolonization within the Asotin Creek Core Area. If after four to five bull trout generations (20 to 25 years), all recovery measures prove ineffective to enhance natural reproduction of wild bull trout, implement a controlled propagation or transplant program. Because newly recolonized local populations within the Asotin Creek Core Area will be inherently small, straying rates and movement of fish to adjacent unoccupied areas may be a slow process. As a result, population growth and full colonization may take significantly longer. Achieving recovery criteria may take an additional four to five generations (20 to 25 years), therefore requiring eight to ten total generations (40 to 50 years) in Asotin Creek.

2. Initiate a controlled propagation or transplantation program to accelerate recovery time. The Snake River Washington Recovery Unit Team would begin this program only after identifying a suitable genetic source (preferably from bull trout within the basin) and completing a stream inventory and analysis (feasibility study). This analysis would identify habitats that meet minimum criteria (*e.g.*, adequate stream size, gradient, flow, groundwater contributions, temperature, pools and spawning substrate, and riparian cover) to support local populations or habitats that, with minimal improvements, could support bull trout local populations. Recovery within the Asotin Creek Core Area may take one to two additional generations (5 to 10 years) beyond the four to five generations needed to significantly reduce identified threats, given that a stream analysis and development of a controlled propagation program could take up to five years. Under this scenario, the recovery unit team expects that recovery criteria for the Asotin Creek Core Area could be achieved within five to seven bull trout generations (25 to 35 years).

The Snake River Washington Recovery Unit Team recommends that the actions described in scenario 2 should be implemented to increase the likelihood of bull trout persistence and recovery in the Asotin Creek Core Area.

ACTIONS NEEDED

Recovery Measures Narrative

In this chapter and all other chapters of the bull trout recovery plan, the recovery measures narrative consists of a hierarchical list of actions that follows a standard template. The first-tier entries are identical in all chapters and represent general recovery tasks under which specific (*e.g.*, third-tier) tasks appear when appropriate. Second-tier entries also represent general recovery tasks under which specific tasks appear. For a complete and thorough discussion of second-tier tasks, see Chapter 1. Second-tier tasks that do not include specific third-tier actions are either programmatic activities that are applicable across the species' range and appear in *italicized font* or are tasks that may not be sufficiently developed to apply to the recovery unit at this time and appear in *an italicized shaded font (as seen here)*. These tasks are included to preserve consistency in numbering tasks among recovery unit chapters and are intended to assist in generating information during the comment period for the draft recovery plan, a period during which additional tasks may be developed. Third-tier entries are tasks specific to the Snake River Washington Recovery Unit. They appear in the Implementation Schedule that follows this section and are identified by three numerals separated by periods.

The Snake River Washington Recovery Unit chapter should be updated or revised when recovery tasks are accomplished, environmental conditions change, or monitoring results or other new information becomes available. Revisions to the Snake River Washington Recovery Unit chapter will probably focus on priority streams or stream segments within core areas where restoration activities occurred and where habitat or bull trout populations have shown a positive response. The Snake River Washington Recovery Unit Team should meet annually to review annual monitoring reports and summaries and to make recommendations to the U.S. Fish and Wildlife Service.

1 Protect, restore, and maintain suitable habitat conditions for bull trout.

1.1 Maintain or improve water quality in bull trout core areas or potential core habitat.

1.1.1 Identify unstable and problem roads causing fine sediment delivery. Survey and identify sediment delivery from County roads associated with the Tucannon River Road. Evaluate roads to identify sediment sources and sediment delivery points during rainstorms and spring runoff. Survey all bridges, culverts, fill slopes, and unstable road sections in areas of known local populations and potential local populations in the Tucannon River and Asotin Creek Core Areas.

1.1.2 Move roads that are in riparian areas out of the floodplain or stabilize them Where possible, move roads out of floodplains along streams that have known local populations of bull trout or streams that have been identified as essential for reestablishing local populations of bull trout. Where roads cannot be moved, stabilize them: recontour road fill slopes and seed with native vegetation to prevent slumping. Add adequate surface material, if needed, to prevent sediment movement.

1.1.3 Find and eliminate fine sediment sources from historical roads. Identify sources of fine sediment input from historical road networks on Federal and State lands that are managed as part of the Federal Wenaha-Tucannon Wilderness or the State-owned Wooten Wildlife Refuge, especially roads along bull trout spawning habitat in the Tucannon River. Reduce and prevent erosion from identified problem locations on motorized access roads and from closed roads at trailheads.

1.1.4 Improve routine road maintenance practices. Road maintenance practices have been identified as adversely affecting bull trout habitat where maintenance occurs on roads next to streams. Change or improve road maintenance protocols on all Federal-, State-, and County- managed roads throughout the Tucannon River and Asotin Creek Core Areas to minimize erosion and riparian damage. Upslope road ditches should be directed to downslope areas away from stream channels and so be prevented from discharging into streams.

1.1.5 Restore stream channels to appropriate channel type. In the Asotin Creek Core Area, address intermittent stream problems in the lower 0.8 kilometer (0.5 mile) in George Creek and restore and maintain a functional, single-thread channel on lower George Creek from river kilometer 2.8 to 5.8 (river mile 1.6 to 3.6) and river kilometer 7.2 to 9.2 (river mile 4.5 to 5.7) by reconstructing meanders and restoring floodplains and riparian zones that contain trees and other sources for recruitment of large woody debris.

1.1.6 Reduce sediment inputs from recreational-based channel damage. Assess damaged areas and reduce sediment input from riparian and streambank alterations caused by motorized and nonmotorized use of access trails along the Tucannon River. Work with the managers of State and Federally owned campgrounds to relocate campgrounds out of the riparian zone and floodplain to prevent further damage to vegetation and streambanks if effective controls are not implemented.

1.1.7 Develop and install educational watershed protection signs in riparian areas of State and Federal campgrounds. In the Tucannon River Core Area, develop readily visible signs and notices asking campground patrons to help protect sensitive stream corridors. In the Asotin Creek watershed, develop riparian protection signs in sensitive streamside areas on State and Federal lands

1.1.8 Review and act on recommendations generated from sediment monitoring and abatement plans. Coordinate and review progress with landowners and land managers on Natural Resources Conservation Service sediment monitoring and abatement plans in the Asotin Creek watershed, especially Charley Creek, North Fork Asotin Creek, South Fork Asotin Creek, George Creek, and the mainstem of Asotin Creek. In the Tucannon River watershed, review and coordinate sediment abatement actions in response to sediment monitoring in Pataha Creek and the mainstem Tucannon River. Promote agricultural practices such as no-till seeding to reduce sediment delivery to streams identified for bull trout recovery.

1.1.9 Assess water quality and remedy impacts from individual residences and communities. Investigate the effects and relative threats to bull trout from septic tank leakage, waste water drainage, and other potential water quality problems originating from the City of Asotin and from the rural residential development concentrated in the lower 8 kilometers (5 miles) of Asotin Creek. In the Tucannon River, investigate the extent of these potential water quality problems at the towns of Starbuck, Marengo, and Pomeroy and at the concentrated rural development along the lower 25 kilometers (16 miles) of the mainstem Tucannon River. Recommendations should be made on actions to remedy water quality impacts.

1.1.10 Evaluate the need to install additional permanent stream gauging stations. Determine whether permanent stream gauging stations would aid enforcement of permitted irrigation diversion volumes and surface water rights in the upper Tucannon River, Pataha Creek, and Asotin Creek. If such stations would aid enforcement, install gauges and monitor stream flows.

1.1.11 Identify sources and locations of groundwater infiltration to streams. In bull trout local populations and potential local populations in the Asotin Creek Core Area, survey, locate, and map areas where groundwater percolates through the streambed and contributes to bull trout habitat. Use this information to correlate bull trout distribution with groundwater inflow and estimate the amount of bull trout habitat available in occupied and unoccupied streams.

1.1.12 Protect groundwater sources to maintain base flows in the Tucannon River and Asotin Creek. Groundwater is an important component of the base flows in the Tucannon River and Asotin Creek watersheds. Identify non-permitted groundwater uses and implement enforcement to protect groundwater sources at Starbuck, Marengo, Pomeroy, and the densely populated rural areas along the mainstem Tucannon River. Promote agricultural practices such as no-till seeding in Asotin Creek to protect base flows.

1.1.13 Identify factors contributing to elevated stream temperatures. Implement water temperature monitoring on State and Federal lands. Identify and correct reasons for temperature exceedences in bull trout migratory and rearing habitat in the Tucannon River and Asotin Creek Core Areas.

1.2 Identify barriers or sites of irrigation entrainment for bull trout and implement tasks to provide passage and eliminate entrainment.

1.2.1 Remove permanent and seasonal barriers to bull trout migration. Identify complete or seasonal barriers caused by debris jams, irrigation wing dams, culvert drops, bridge crossings, or other manmade structures that hinder or prevent bull trout from accessing upstream spawning or rearing habitat in both core areas. In Asotin Creek, survey all culverts at various flows in the mainstem of Asotin Creek, especially the main Asotin Creek Road culvert and the Charley Creek crossing, to make sure each is passable by adult and subadult bull trout. Evaluate fish passage and repair, if necessary, the perched road culvert at the Trent Ridge Road crossing in George Creek and the in-channel pond that may be a bull trout passage barrier.

1.2.2 Eliminate barriers to bull trout passage at remnant power and irrigation dams. Remove or modify the remnant Headgate Dam structure and existing fish ladder in Asotin Creek, and the Starbuck Dam structure in the Tucannon River, to allow free unimpeded movement of bull trout both upstream and downstream during all flow conditions.

1.2.3 Conduct a complete inventory of surface water diversions. Inventory all surface water diversions in the Tucannon River and Asotin Creek Core Areas. Evaluate compliance with State, U.S. Fish and Wildlife Service, and the National Marine Fisheries Service screening criteria. Screen all diversions to meet State and Federal requirements.

1.3 Identify impaired stream channels and riparian areas and implement tasks to restore their appropriate functions.

1.3.1 Conduct watershed analyses to evaluate past, current, and future bull trout production potential. In the Tucannon River and Asotin Creek Core Areas, conduct watershed analyses to describe the past, current, and future (restored) potential of mainstem reaches and tributary streams to support bull trout recovery. To aid in adaptive management of recovery goals, identify site-specific tasks for recovery actions appropriate for individual watersheds. Watershed analyses are intended to generate a holistic understanding of land use and stream conditions within a watershed. Analyses should identify likely historical conditions that can be used to develop restoration actions and to prioritize problems within a watershed. A complete watershed analysis should contain, at a minimum, assessments for roads, riparian areas, channel and flow characteristics, water temperatures, and habitat size. Relate watershed study plan to the needs of bull trout.

1.3.2 Identify streambanks susceptible to excessive failure and mass wasting. On National Forest lands in the Tucannon River and Asotin Creek watersheds, complete a road network survey to identify and map all stream reaches with actively eroding streambanks that are susceptible to excessive failure during high-flow events. Identify all head-cuts and incidences of mass wasting that may negatively impact riparian areas and inhibit natural stream functions.

1.3.3 Stabilize streambeds and banks. In Charley Creek, an Asotin Creek tributary, permanently repair active head-cut damage and revegetate the stream channel where mass wasting problems are associated with failure of two fishing ponds constructed in the stream channel. Head-cuts have enlarged this area, and excessive sediment is delivered to the lower reaches of Charley Creek and Asotin Creek. Repair streambanks in the Asotin Creek and Tucannon River watersheds on State and National Forest lands where streamside grazing occurs and where past timber harvest occurred with no stream buffer. Develop additional private landowner cooperation to restore streambanks, stream function, and floodplain connectivity on private grazing and agricultural lands along stream corridors.

1.3.4 Protect riparian and channel habitat at managed and unmanaged campgrounds, trail systems, and recreation sites.

Develop riparian and stream channel management plans to protect migration, spawning, and rearing habitat adjacent to trail systems, camping sites, and recreation sites. Relocate campgrounds out of riparian areas when necessary to avoid impacts to bull trout habitat. Restore and protect riparian and channel habitat along heavily used trails and trailheads.

1.3.5 Develop and implement comprehensive livestock grazing management plans. Develop, implement, and revise, when necessary, adaptive livestock grazing management plans. Include mid-season performance standards that maintain stream channel conditions for quality bull trout spawning and rearing habitat.

1.3.6 Identify and restore riparian vegetation in priority streams. Identify sites and revegetate to restore shade and canopy, riparian cover, and native vegetation to improve or maintain bull trout habitat.

1.3.7 Evaluate legacy effects from two historic mines on Cummings Creek. Evaluate current and legacy effects of mining to eliminate negative effects or to improve conditions.

1.3.8 Reduce fine sediment inputs from agricultural land. Identify sources and work with landowners and agriculture agencies to reduce fine sediment inputs to the Tucannon River and its largest tributary, Pataha Creek. In Asotin Creek, identify and reduce sediment sources to George, Pintler, Charley, and Lick Creeks.

1.3.9 Maintain roadless conditions in sensitive bull trout watersheds. Maintain roadless conditions on U.S. Forest Service lands in the Tucannon River and Asotin Creek watersheds to protect bull trout headwater spawning and rearing areas.

1.3.10 Evaluate bridge crossings and assess options to modify structures to protect migration corridors. Evaluate the more than 20 bridge crossings in the Tucannon River watershed. Investigate the feasibility of installing appropriately designed crossings or culverts to improve channel function and fish passage at bridge sites or other crossings and make modifications where feasible.

1.3.11 Incorporate non-intrusive flood repair activities. Provide technical assistance to Asotin County, Columbia County, and private landowners on options for fish-friendly flood repair techniques that will help to improve or restore channel processes that benefit bull trout or their habitat. Much of the streambank along urbanized sections of the Tucannon River has been channelized, ditched, armored, or riprapped to protect roads and infrastructure.

1.3.12 Promote programs to restore and protect floodplain and channel function. Identify, promote, and continue incentives through the Asotin County, Columbia County, and Pomeroy Conservation Districts to promote programs centered on restoring floodplain and channel function in the mainstem of Asotin Creek below Headgate Dam and along the Tucannon River at the communities of Starbuck, Marengo, and Pomeroy.

1.3.13 Identify and restore aggrading stream channels to restore flow and reduce subsurface flows and increase channel stability. Conduct stream surveys to identify or better define problems and possible solutions to restore stream channel stability, function, complexity, and bedload sources that lead to reduced surface flow and increased subsurface flow at the confluence of streams. Use this information to guide restoration activities in the Tucannon River Core Area, especially Charley, Cummings, and Pataha Creeks. Conduct the same surveys in the Asotin Creek Core Area, particularly in the mainstem of Asotin Creek and in George, Wormell Gulch, and South Fork Asotin Creeks.

1.3.14 Investigate land acquisition from willing sellers as an opportunity to protect bull trout. Where appropriate, pursue land purchases, easements, and agreements in the Tucannon River and Asotin Creek Core Areas along stream corridors that contain sensitive bull trout spawning, migrating, and rearing habitat. Pursue land exchanges with agencies and nongovernmental organizations to protect bull trout areas from future urban development and initiate activities to restore riparian and channel function when appropriate to protect bull trout habitat.

1.3.15 Reduce stream temperatures by enhancing riparian area. Reduce summer stream temperatures by restoring riparian forest buffers in both core areas. In the Asotin Creek Core Area, reduce temperatures in the mainstem of Asotin Creek, lower Charley Creek, George Creek, and South Fork Asotin Creek. In the Tucannon River Core Area, restore riparian vegetation or areas to help reduce summer temperatures on the mainstem Tucannon River from Marengo downstream, especially in the Wooten Wildlife Area, and in Pataha Creek from Columbia Center downstream to the confluence with the Tucannon River.

1.3.16 Reduce impacts of livestock on streams and riparian areas. To reduce impacts from livestock, work with landowners, managers, and agriculture agencies to fence around streams and riparian areas in both core areas. Develop off-site livestock watering facilities.

1.3.17 Minimize further development in floodplains. Work with City and County agencies to rezone riparian areas or to develop a riparian area protection policy. Reduce or eliminate additional development of floodplain areas in the Tucannon River and Asotin Creek for any purpose except to dissipate flood water and energy or to perform restoration activities. Where possible, restore floodplain connectivity.

1.4 Operate dams to minimize negative effects on bull trout.

1.4.1 Implement bull trout identification protocol at juvenile and adult fishways at Lower Monumental, Little Goose, and Lower Granite Dams. Fully implement the bull trout identification protocol proposed by the U.S. Army Corps of Engineers to identify and count adult and juvenile bull trout at anadromous fish passage facilities. Elevate the importance of bull trout monitoring to counting personnel. Report results in electronic, tabulated form to the Snake River Washington Recovery Unit coordinator on an annual basis.

1.4.2 Review existing bull trout information and determine limiting factors affecting bull trout at Lower Monumental, Little Goose, and Lower Granite Dams. Analyze existing biological information and determine whether there are limiting factors causing take of bull trout that have not already been addressed through dam operations for salmon and steelhead.

1.4.3 Identify study needs related to habitats for foraging, migrating, and overwintering in Snake River reservoirs. Determine research needs associated with the operation of Lower

Monumental Dam, Little Goose, and Lower Granite Dams and with movement of bull trout from tributary streams into, and through, associated reservoirs. Conduct research on identified topics and then implement feasible remedies.

1.5 Identify upland conditions negatively affecting bull trout habitats and implement tasks to restore appropriate functions.

1.5.1 <u>Assess effects of upland activities and current upland conditions on stream and riparian function</u>. In the Asotin Creek watershed, identify adverse impacts to the stream system from tumbleweed dams and upland soil erosion that contributes to excess fines deposited in the streambed. In the Tucannon River watershed, identify measures to control upland soil erosion from rangeland. Implement corrective measures in both core areas.

1.5.2 <u>Assess current and historical effects of upland management on occupied bull trout streams</u>. Evaluate effects of upland management, particularly timber management, and agriculture and grazing practices in the Asotin Creek and Tucannon River Core Areas. Assess changes to the stream hydrographs, for example, timing and magnitude of both base and peak flows, and sediment sources that reach streams from upland sites. Use information to improve upland activities to increase base stream flows.

1.5.3 <u>Investigate use of prescribed fire</u>. Evaluate the use of prescribed fire to mimic natural disturbance to reinvigorate forested watersheds in both core areas. Review fire suppression efforts and emphasize continued fire suppression to reduce the risk of catastrophic fire, while not putting bull trout watersheds at risk. In Asotin Creek, evaluate methods to reduce the potential for wildfire in North Fork Asotin Creek and Cougar Creek to protect small local populations.

2 Prevent and reduce negative effects of nonnative fishes and other nonnative taxa on bull trout.

2.1 Develop, implement, and enforce public and private fish stocking policies to reduce stocking of nonnative fishes that affect bull trout.

2.1.1 Evaluate potential impacts of hatchery rainbow trout. Review and address potential impacts from continuing rainbow trout stocking programs in Spring, Blue, Rainbow, Deer, Watson, Beaver, Big Four, and Curl Lakes. Review the effectiveness of existing policies for public and private fish stocking for minimizing impacts on bull trout. Take action based on the results to reduce the risks to bull trout of unwanted fish introductions.

2.2 Evaluate enforcement of policies for preventing illegal transport and introduction of nonnative fishes.

2.3 Provide information to the public about ecosystem concerns of illegal introductions of nonnative fishes.

2.4 Evaluate the biological, economic, and social effects of control of nonnative fishes.

2.4.1 Evaluate impacts of nonnative fish species on bull trout. Upon evaluation of impacts from nonnative species, develop and implement strategies for removing or reducing nonnative fish that may compete directly for food and space with juvenile, subadult, or adult bull trout. Predetermine whether removal of any species is biologically feasible and whether removal is economically and socially supportable in the Tucannon River and Asotin Creek Core Areas. Maintain current efforts at the Tucannon River Hatchery fish trap to stop upstream movement of bridgelip suckers and other nonnative fish.

2.4.2 Perform feasibility analysis to remove brook trout in Pataha Creek. Study the physical and economic potential for experimental removal of brook trout from Pataha Creek. Provide recommendations for methodologies and time frames.

2.5 Implement control of nonnative fishes where found to be feasible and appropriate.

2.5.1 Determine distribution and abundance of brook trout. Brook trout are believed to be partially responsible for extirpation of bull trout in Pataha Creek. Conduct fish surveys to determine the distribution and abundance of brook trout in Pataha Creek and the mainstem of the Tucannon River upstream from the mouth of Pataha Creek. Map brook trout distribution and calculate relative abundance to aid in the feasibility analysis for removing brook trout from Pataha Creek.

2.5.2 Encourage brook trout harvest in Pataha Creek. Remove harvest limits for brook trout to encourage harvest of the fish in Pataha Creek. Implement management strategies to ensure that brook trout populations do not expand into the Tucannon River from Pataha Creek.

2.5.3 Implement experimental removal of brook trout. If feasible, initiate a brook trout eradication program in Pataha Creek to assist with reestablishment of bull trout into Pataha Creek from the Tucannon River.

2.6 Develop tasks to reduce negative effects of nonnative fishes on bull trout.

2.6.1 Evaluate potential impacts from fish competition. Determine whether competition for resources occurs between bull trout and nonnative species and evaluate the potential negative impacts on juvenile and subadult bull trout in rearing areas of the Tucannon River and Asotin Creek. Impacts from competition with nonnative species and juvenile, subadult, and adult bull trout should be addressed in the lower Tucannon River (3 kilometers, or 2 miles), in areas that may serve as foraging, migrating, or overwintering habitat.

3 Establish fisheries management goals and objectives compatible with bull trout recovery and implement practices to achieve goals.

3.1 Develop and implement State and Tribal native fish management plans integrating adaptive research.

3.2 Evaluate and prevent poaching and incidental angling mortality of bull trout.

3.2.1 Reduce incidental harvest by outreach to recreational anglers and increasing awareness of bull trout population status. Reduce unintentional harvest of bull trout and mortality from catch-and-release fishing by making public education materials available and establishing interpretive signs at all high-use fishing access points. Increase education efforts during the steelhead fishing season when bait is allowed for steelhead angling. Education materials should include information on bull trout identification, fishing regulations, agency contacts, and appropriate catch-and-release handling techniques. Continue cooperating on education projects with the Native

American Tribes, the U.S. Forest Service, the Washington Department of Fish and Wildlife, the U.S. Fish and Wildlife Service, anglers, other recreational organizations, and local newspapers.

3.2.2 Summarize existing bull trout bycatch (incidental capture) data and implement angler interviews that target bull trout bycatch. Review catch data for legal sport fisheries, especially for steelhead in the Tucannon River, to determine bull trout bycatch and estimate catch-and-release mortality. Implement a standard creel survey protocol that specifically targets bull trout bycatch information during steelhead angler interviews in the fall, winter, and spring. Implement the same protocol for anglers seeking other species during the summer. Use this information to support distribution and abundance trends for bull trout in both core areas and provide this information to the recovery unit coordinator on an annual basis.

3.2.3 Increase enforcement patrols during spawning periods. To reduce poaching of spawning adult bull trout, increase and focus State and Federal enforcement in all priority spawning streams, especially along easily accessible areas of the mainstem Tucannon River between Panjab Creek and Bear Creek during September, October, and November. Large fluvial bull trout (35 to 65 centimeters, or 14 to 26 inches) in the Tucannon River are particularly vulnerable and need increased protection during fall periods when recreational activities (fishing, hunting, and hiking) are high.

3.2.4 Minimize incidental bull trout mortality from angler-related hooking and handling. Reduce or eliminate angler impacts in open fishing areas where incidental mortality continues to be detrimental, especially in the mainstem Tucannon River between Cummings Creek and Panjab Creek and in stream areas directly accessible by patrons of State and Federal campgrounds.

3.2.5 Use , review, and revise, where necessary, management goals for bull trout. Make efficient use of existing State and Federal fisheries management guidelines and policies designed to protect bull trout. Elevate bull trout priority when considering management actions for listed Snake River steelhead and spring chinook salmon.

3.3 Evaluate potential effects of nonnative fishes and associated sport fisheries on bull trout recovery and implement tasks to minimize negative effects on bull trout.

3.4 Evaluate effects of existing and proposed sport fishing regulations on bull trout.

3.4.1 Continue bull trout harvest closure in the Snake River Washington Recovery Unit. Continue implementing and enforcing fishing closures for bull trout in the Tucannon River and Asotin Creek Core Areas, at least until bull trout abundance and distribution have been fully determined, threats to production and population stability have been removed, and numbers of spawning adults show a definite increasing trend and have met recovery criteria.

4 Characterize, conserve, and monitor genetic diversity and gene flow among local populations of bull trout.

4.1 Incorporate conservation of genetic and phenotypic attributes of bull trout into recovery and management plans.

4.1.1 Conduct genetic inventory. Collect samples for genetic analyses to contribute to establishing a program to understand genetic baseline and monitor genetic changes throughout the range of bull trout (see Chapter 1). Asotin Creek and the Tucannon River Core Areas are separated by the mainstem hydroelectric facilities at Little Goose and Lower Granite Dams. Although genetic analyses have not been initiated to provide conclusive evidence, interbreeding between these populations is very unlikely because of the physical distance separating these streams. Additional genetic information is needed to validate the separation of bull trout within the core areas of the Snake River Washington Recovery Unit. In Asotin Creek, collect tissue samples in a nonlethal manner and complete genetic analyses on bull trout in North Fork Asotin Creek and Cougar Creek. Genetic work for Asotin Creek bull trout must include objectives to determine whether a viable population exists and whether inbreeding depression has become a factor that could hinder recovery efforts. If time and money prevent simultaneous collection and evaluation of samples in both core areas, genetic analysis of Asotin Creek fish is a priority over that of Tucannon River fish. For the Tucannon River, collect tissue samples nonlethally from adult, subadult, and juvenile bull trout and complete a genetic analysis. Collect samples from populations using the mainstem Tucannon River between Panjab and Bear Creek and from direct tributaries including Cold, Sheep, Bear, Panjab, Meadow, Turkey, and Little Turkey Creeks. This genetic work is needed to provide an understanding of the genetic structure of local populations in both core areas and to provide a baseline from which to monitor genetic similarities and differences between bull trout in adjacent recovery units.

4.1.2 Evaluate and describe the genetic structure of bull trout in local populations. In the Tucannon River watershed, Panjab Creek supports bull trout spawners in two of its tributaries, Meadow Creek and Turkey Creek. Bull trout also spawn in one of Meadow Creek's tributaries, Little Turkey Creek, and in the mainstem of Panjab Creek. All known spawning locations are headwater tributaries in close proximity to each another and have been described in the past as a single population. Evaluate genetic data to determine whether bull trout in Panjab Creek and its tributaries are a single spawning local population or multiple local populations that show genetic divergence. In Asotin Creek, evaluate the genetic structure of bull trout in Cougar Creek, North Fork Asotin Creek, and other potential local populations.

4.1.3 Perform genetic analyses on brook trout from Pataha Creek to determine whether hybridization between brook trout and bull trout has occurred. Collect tissue samples from brook trout in Pataha Creek to determine whether brook trout have hybridized with bull trout.

4.1.4 Monitor genetic changes in numbers and life forms to maintain long-term viability of bull trout in the Snake River Washington Recovery Unit (see discussion on monitoring and evaluation in Chapter 1).

4.2 Maintain existing opportunities for gene flow among bull trout populations.

4.3 Develop genetic management plans and guidelines for appropriate use of transplantation and artificial propagation.

4.3.1 Evaluate the genetic risks and benefits of reintroduction of bull trout. Evaluate the benefits and risks of introducing non-local bull trout genes into Asotin Creek. If benefits of reintroduction are greater than risks and if natural recolonization is determined not timely enough to likely avoid local extirpations of bull trout in the watershed, develop genetic reserve protocols and standards for initiating, conducting, and evaluating a captive propagation program for Asotin Creek. Evaluate potential genetic sources from Tucannon River bull trout for possible reintroduction of bull trout into Pataha Creek following initial surveys of fish distribution and habitat conditions, restoration activities, and brook trout removal.

5 Conduct research and monitoring to implement and evaluate bull trout recovery activities, consistent with an adaptive management approach using feedback from implemented, site-specific recovery tasks.

5.1 Design and implement a standardized monitoring program to assess the effectiveness of recovery efforts affecting bull trout and their habitats.

5.2 Conduct research evaluating relationships among bull trout distribution and abundance, bull trout habitat, and recovery tasks.

5.2.1 <u>Conduct presence and absence surveys to fully describe the distribution of juvenile, subadult, and adult bull trout</u>. Conduct standardized, intensive, and statistically sound electrofishing and/or snorkeling surveys in the upper mainstem of the Tucannon River from Tumalum Creek to Bear Creek and in tributaries including the Little Tucannon River and Cummings, Cold, Sheep, Bear, Panjab, Meadow, Turkey, Little Turkey, Hixon, and upper Pataha Creeks. In Asotin Creek, conduct the same intensive surveys in North Fork Asotin Creek, Cougar Creek, and other potential local populations. Design surveys to describe the full distribution and abundance of juvenile and subadult bull trout in the Tucannon River and Asotin Creek. Standardize and describe sampling methods and sampling locations to allow repeatability of surveys. Repeat surveys every five to six years to facilitate assessment of effectiveness of recovery efforts through time and evaluate progress towards recovery goals.

5.2.2 Determine whether the hydropower system on the lower Snake River is adversely affecting migratory bull trout in the Tucannon River Core Area. Implement the three year radio-telemetry study (2002 to 2005) being proposed by the U.S. Fish and Wildlife Service to help meet reasonable and prudent measures and conservation recommendations associated with the lower Snake River Dams as outlined in the *Biological Opinion* for Federal Columbia River Power System for 2000 (USFWS 2000). This study will help to determine whether Tucannon River bull trout use the mainstem of the Snake River and, if they do, to help define the spatial and temporal distribution and movements of bull trout in lower Snake River reservoirs.

5.2.3 Conduct feasibility studies for artificial propagation and/or transplantation and implement programs. Conduct feasibility studies in the Asotin Creek Core Area and the Tucannon River Core Area to determine which tributaries or stream reaches contain habitat elements (*e.g.*, substrate, flow, temperature, groundwater contribution, pool habitat, spawning habitat, and riparian cover) necessary to support local populations that may be introduced via an artificial propagation program. Evaluate appropriate genetic sources, rearing techniques, and post-release monitoring protocols. Use results to develop and implement an artificial propagation program for potential streams in both core areas.

5.3 *Conduct evaluations of the adequacy and effectiveness of current and past best management practices in maintaining or achieving habitat conditions conducive to bull trout recovery.*

5.4 *Evaluate effects of diseases and parasites on bull trout and develop and implement strategies to minimize negative effects.*

5.5 *Develop and conduct research and monitoring studies to improve information concerning the distribution and status of bull trout.*

5.6 *Identify evaluations needed to improve understanding of relationships among genetic characteristics, phenotypic traits, and local populations of bull trout.*

6 Use all available conservation programs and regulations to protect and conserve bull trout and bull trout habitats.

6.1 Use partnerships and collaborative processes to protect, maintain, and restore functioning core areas for bull trout.

6.1.1 Identify partnership opportunities. Provide technical assistance to Asotin County Conservation District, Pomeroy Conservation District, and Columbia County Conservation District to identify cooperative restoration projects on private lands in the Asotin Creek and Tucannon River watersheds. Increase technical assistance to landowners for grazing management and agricultural practices; use existing Federal, State, and Native American Tribe cost-share programs and incentives to implement actions identified.

6.2 *Use existing Federal authorities to conserve and restore bull trout.*

6.3 Enforce existing Federal and State habitat protection standards and regulations and evaluate their effectiveness for bull trout conservation.

6.3.1 <u>Work with involved agencies to modify emergency flood repair regulations that may impact bull trout habitat</u>. Work with Asotin County and Columbia County to review emergency flood control procedures and, if possible, alter activities and regulations to reduce long-term impacts to bull trout habitat. For example, refrain from constructing more dike and riprap structures that cannot be removed after flood waters recede.

7 Assess the implementation of bull trout recovery by recovery units and revise recovery unit plans based on evaluations.

7.1 Convene annual meetings of each recovery unit team to generate progress reports on implementing the recovery plan for the U.S. Fish and Wildlife Service.

7.2 Develop and implement a standardized monitoring program to evaluate the effectiveness of recovery efforts.

7.3 Revise scope of recovery as suggested by new information.

7.3.1 <u>Establish a Snake River Washington Recovery Unit bull trout coordinator</u>. Identify a Snake River Washington Recovery Unit Team member to tally and summarize all projects that will benefit bull trout, coordinate the methods and collection of population trend data, store and organize survey and trend data, distribute information on recovery task status, and redirect recovery efforts within the scope of this Snake River Washington Recovery Unit chapter to reflect new information.

7.3.2 Periodically review progress toward recovery goals and assess recovery task priorities. Annually review progress toward population and adult abundance criteria and recommend changes, as needed, to the Snake River Washington Recovery Unit chapter. In addition, review tasks, task priorities, completed tasks, budget, time frames, particular successes, and feasibility within the Snake River Washington Recovery Unit.

IMPLEMENTATION SCHEDULE

The Implementation Schedule that follows describes recovery task priorities, task numbers, task descriptions, duration of tasks, potential or participating responsible parties, total cost estimate, estimates for the next five years, if available, and comments. These tasks, when accomplished, are expected to lead to recovery of bull trout in the Snake River Washington Recovery Unit. Costs estimates are not provided for tasks that are normal agency responsibility under existing authorities.

Most recovery measures for bull trout and bull trout habitat fall under the categories of "research and monitoring," "protection," and "restoration." The Snake River Washington Recovery Unit Team emphasizes the need to expedite the implementation of population studies that will provide information to fill numerous data gaps for bull trout in both the Tucannon River and Asotin Creek Core Areas. In addition, it will be important to simultaneously implement recovery measures to protect existing tributary populations and the diverse habitats essential to their survival. The Snake River Washington Recovery Unit Team acknowledges that many restoration activities will be necessary to recover bull trout throughout the Snake River Washington Recovery Unit. Therefore, the Snake River Washington Recovery Unit Team developed recovery criteria for selecting the streams that should receive the highest priority for restoration and recovery activities. In addition, the Snake River Washington Recovery Unit Team identified the mainstem reaches of the Tucannon River and Asotin Creek as waterbodies that should also be high priorities for restoration and recovery activities. It is important to note that some restoration activities may take many years to complete (10 to 20 years) and, in some cases, even more time will be required before populations respond to improved conditions. Therefore, implementing priority recovery tasks as early as possible is important.

Parties with authority, responsibility, or expressed interest in implementing a specific recovery task are identified in the Implementation Schedule. Listing a responsible party does not imply that prior approval has been given or require that party to participate or expend any funds. However, willing participants may be able to increase their funding opportunities by demonstrating that their budget submission or funding request is for a recovery task identified in an approved recovery plan and is, therefore, part of a coordinated effort to recover bull trout. In addition, section 7 (a)(1) of the Endangered Species Act directs all Federal agencies to use their authorities to further the purposes of the Act by implementing programs for the conservation of threatened or endangered species.

Following are definitions to column headings and keys to abbreviations and acronyms used in the Implementation Schedule:

Priority Number: All priority 1 tasks are listed first, followed by priority 2 and priority 3 tasks.

Priority 1: All actions that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

Priority 2: All actions that must be taken to prevent a significant decline in species population or habitat quality or to prevent some other significant negative effect short of extinction.

Priority 3: All other actions necessary to provide for full recovery (or reclassification) of the species.

Task Number and Task Description: Recovery tasks as numbered in the recovery outline. Refer to the action narrative for task descriptions.

Task Duration: Expected number of years to complete the corresponding task.

Study designs can incorporate multiple tasks, which, when combined, may reduce the time needed for completion.

Responsible or Participating Party: The following organizations are those with responsibility or capability to fund, authorize, or carry out the corresponding recovery task.

Federal agencies:

EPA	Environmental Protection Agency
FHA	Federal Highway Administration
NMFS	National Marine Fisheries Service
NRCS	Natural Resources Conservation Service
USACE	U.S. Army Corps of Engineers
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

State agencies:

WDFW	Washington Department of Fish and Wildlife
WDOE	Washington Department of Ecology
WDNR	Washington Department of Natural Resources
WDOT	Washington Department of Transportation

Others:

ACCD	Asotin County Conservation District
BPA	Bonneville Power Administration
CCD	Columbia County Conservation District
CCWB	Columbia County Weed Board
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
GCCD	Garfield County Conservation District
NGO	Nongovernmental agencies
PCD	Pomeroy Conservation District
SRFB	Salmon Recovery Funding Board

An asterisk (*) indicates agency or agencies that have the lead role for task implementation and coordination, though not necessarily sole responsibility.

Cost Estimates: Cost estimates are rough approximations and provided only for general guidance. Total costs are estimated for the duration of the task and also itemized annually for the next five years.

An asterisk (*) in the total cost column indicates ongoing tasks that are currently being implemented as part of normal agency responsibilities under existing authorities. Because these tasks are not being done specifically or solely for bull trout conservation, they are not included in the cost estimates. Some of these efforts may be occurring at reduced funding levels and/or in only a small portion of the watershed.

Double asterisk (**) in the total cost column indicates that estimated costs for these tasks are not determinable at this time. Input is requested to help develop reasonable cost estimates for these tasks.

Triple asterisk (***) indicates costs are combined with or embedded within other related tasks.

Implementation schedule for the bull trout recovery plan: Snake River Washington Recovery Unit: Tucannon River Core Area											
Task Priority	Task Number	Task description	Task duration (years)	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	1.1.1	Identify unstable and problem roads causing fine sediment delivery	25	CCD, GCCD, USFS, WDOT	10	10	-	-	-	-	Existing agency responsibilities; costs associated with non-agency lands
2	1.1.2	Move roads that are in riparian areas out of the floodplain or stabilize them	25	CCD, GCCD, USFS, WDOT	**	-	-	-	-	-	Existing agency responsibilities; costs unknown as each road may require different solutions
2	1.1.3	Find and eliminate fine sediment sources from historical roads	25	CCD, GCCD, USFS, WDOT	**	-	-	-	-	-	Existing agency responsibilities;costs unknown as each road may require different solutions
2	1.1.4	Improve routine road maintenance practices	25	CCD, GCCD, USFS, WDOT	*	-	-	-	-	-	Existing agency responsibilities
2	1.1.6	Reduce sediment inputs from recreational-based channel damage	25	USFS, WDFW	*	-	-	-	-	-	Existing agency responsibilities

Implementation schedule for the bull trout recovery plan: Snake River Washington Recovery Unit: Tucannon River Core Area											
Task Priority	Task Number	Task description	Task duration (years)	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	1.1.7	Develop and install educational watershed protection signs in riparian areas of State and Federal campgrounds	3	USFS, WDFW	5	5	-	-	-	-	
2	1.1.8	Review and act on recommendations generated from sediment monitoring plans	25	CCD, CTUIR, NRCS, PCD, USFS, WDFW	*	-	-	-	-	-	Existing agency responsibilities
2	1.1.9	Assess water quality and remedy impacts from individual residences and communities	25	CCD, WDOE	*	-	-	-	-	-	Existing agency responsibilities
2	1.1.12	Protect groundwater sources to maintain base flows in the Tucannon River	25	EPA, WDOE, WDFW, USFS	*	-	-	-	-	-	Existing agency responsibilities;
2	1.1.13	Identify factors contributing to elevated stream temperatures	3	CCD, PCD, WDFW, USFS	*	-	-	-	-	-	Existing agency responsibilities
2	1.2.1	Remove permanent and seasonal barriers to bull trout migration	25	CCD, PCD, WDFW, USFS	*	-	-	-	-	-	Existing agency responsibilities

Implementation schedule for the bull trout recovery plan: Snake River Washington Recovery Unit: Tucannon River Core Area											
Task Priority	Task Number	Task description	Task duration (years)	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	1.2.2	Eliminate barriers to bull trout passage at remnant power and irrigation dams	5	CCD, WDFW, NRCS	*	-	-	-	-	-	Existing agency responsibilities
2	1.2.3	Conduct a complete inventory of surface water diversions	3	CCD, PCD, WDFW, WDOE	15	-	15	-	-	-	
2	1.3.1	Conduct watershed analyses to evaluate past, current, and future bull trout production potential	10	WDFW, USFS, USFWS	*	-	-	-	-	-	Focus on critical habitat and associated waters
2	1.3.2	Identify streambanks susceptible to excessive failure and mass wasting	25	CCD, PCD, WDFW, USFS	*	-	-	-	-	-	Existing agency responsibilities
2	1.3.3	Stabilize streambeds and banks	25	CCD, NRCS, PCD, WDFW, USFS	*	-	-	-	-	-	Existing agency responsibilities
2	1.3.4	Protect riparian and channel habitat at managed and unmanaged campgrounds, trail systems, and recreation sites	25	USFS, WDFW	*	-	-	-	-	-	Existing agency responsibilities

Implementation schedule for the bull trout recovery plan: Snake River Washington Recovery Unit: Tucannon River Core Area											
Task Priority	Task Number	Task description	Task duration (years)	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	1.3.6	Identify and restore riparian vegetation in priority streams	25	CCD, USFS, WDFW	*	-	-	-	-	-	Existing agency responsibilities
2	1.3.8	Reduce fine sediment inputs from agricultural land	25	CCD, PCD, NRCS, WDOE	*	-	-	-	-	-	Existing agency responsibilities
2	1.3.9	Maintain roadless conditions in sensitive bull trout watersheds	25	USFS	*	-	-	-	-	-	Existing agency responsibilities
2	1.3.10	Evaluate bridge crossings and assess options to modify structures to protect migration corridors	3	CCD, GCCD, USFS, WDOT, FHA	*	-	-	-	-	-	Existing agency responsibilities
2	1.3.12	Promote programs to restore and protect floodplain and channel function	25	CCD, PCD, NRCS, WDFW, USFS	*	-	-	-	-	-	Existing agency responsibilities
2	1.3.13	Identify and restore aggrading stream channels to restore flow and reduce subsurface flows and increase channel stability	25	CCD, PCD, NRCS, WDFW, WDOE, USFS	10	-	10	-	-	-	Surveys only

Implementation schedule for the bull trout recovery plan: Snake River Washington Recovery Unit: Tucannon River Core Area											
Task Priority	Task Number	Task description	Task duration (years)	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	1.3.15	Reduce stream temperatures by enhancing riparian areas	25	CCD, EPA, PCD, WDFW, WDOE, USFS	*	-	-	-	-	-	Existing agency responsibilities
2	1.3.16	Reduce impacts of livestock on streams and riparian areas	25	CCD, PCD, USFS	*	-	-	-	-	-	Existing agency responsibilities
2	1.4.1	Implement bull trout identification protocol at juvenile and adult fishways at Lower Monumental, Little Goose, and Lower Granite Dams	25	USACE	*	-	-	-	-	-	Existing agency responsibilities
2	1.4.2	Review existing bull trout information and determine limiting factors affecting bull trout at Lower Monumental, Little Goose, and Lower Granite Dams	2	USACE, WDFW, USFWS	*	-	-	-	-	-	Existing agency responsibilities

Implementation schedule for the bull trout recovery plan: Snake River Washington Recovery Unit: Tucannon River Core Area											
Task Priority	Task Number	Task description	Task duration (years)	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	1.4.3	Identify study needs related to habitats for foraging, migrating, and overwintering in Snake River reservoirs	3	USACE, WDFW, USFWS	*	-	-	-	-	-	Costs covered by task 7.3.1
2	3.2.1	Reduce incidental harvest by outreach to anglers and increasing awareness of bull trout population status	25	WDFW	*	-	-	-	-	-	Existing agency responsibilities
2	3.2.2	Summarize existing bull trout bycatch data and implement angler interviews that target bull trout bycatch	25	WDFW	*	-	-	-	-	-	Existing agency responsibilities
2	3.2.3	Increase enforcement patrols during spawning periods	25	WDFW	15	5	-	5	-	5	
2	3.4.1	Continue bull trout harvest closure in the Snake River Washington Recovery Unit	25	WDFW	*	-	-	-	-	-	Existing agency responsibilities
2	4.1.1	Conduct genetic inventory	5	USFS, USFWS, WDFW	50	25	25	-	-	-	

Implementation schedule for the bull trout recovery plan: Snake River Washington Recovery Unit: Tucannon River Core Area											
Task Priority	Task Number	Task description	Task duration (years)	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	4.1.2	Evaluate and describe the genetic structure of bull trout in local populations	5	USFS, USFWS, WDFW	5	-	5	-	-	-	
2	5.2.1	Conduct presence and absence surveys to fully describe the distribution of juvenile, subadult, and adult bull trout	3	USFS, WDFW	60	20	20	20	-	-	
3	1.1.10	Evaluate the need to install additional permanent stream gauging stations	2	WDFW, WDOE, USGS	10	10	-	-	-	-	Costs only for the study
3	1.3.5	Develop and implement comprehensive livestock grazing management plans	25	CCD, NRCS, PCD, USFS	*	-	-	-	-	-	Existing agency responsibilities
3	1.3.7	Evaluate legacy effects from two historical mines on Cummings Creek	3	USFS, WDOE	5	-	-	5	-	-	
3	1.3.11	Incorporate non-intrusive flood repair strategies	25	CCD, GCCD, FHA, USFS, WDOT	*	-	-	-	-	-	Existing agency responsibilities

Implementation schedule for the bull trout recovery plan: Snake River Washington Recovery Unit: Tucannon River Core Area											
Task Priority	Task Number	Task description	Task duration (years)	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
3	1.3.14	Investigate land acquisition from willing sellers as an opportunity to protect bull trout	25	USFS, WDFW	*	-	-	-	-	-	Existing agency responsibilities
3	1.3.17	Minimize further development in floodplains	25	CCD, PCD, WDFW, USFS	*	-	-	-	-	-	Existing agency responsibilities
3	1.5.1	Assess effects of upland activities and current upland conditions on stream and riparian function	5	CCD, CCWB	*	-	-	-	-	-	Existing agency responsibilities
3	1.5.2	Assess current and historical effects of upland management on occupied bull trout streams	5	CCD, CCWB	*	-	-	-	-	-	Existing agency responsibilities
3	1.5.3	Investigate use of prescribed fire	5	USFS	*	-	-	-	-	-	Existing agency responsibilities
3	2.1.1	Evaluate potential impacts of hatchery rainbow trout	5	WDFW	*	-	-	-	-	-	Existing agency responsibilities
3	2.4.1	Evaluate impacts of nonnative fish species on bull trout	5	WDFW, USFS, USFWS, NMFS	*	-	-	-	-	-	Existing agency responsibilities

Implementation schedule for the bull trout recovery plan: Snake River Washington Recovery Unit: Tucannon River Core Area											
Task Priority	Task Number	Task description	Task duration (years)	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
3	2.4.2	Perform feasibility analysis to remove brook trout in Pataha Creek	5	USFS, WDFW, USFWS	10	-	10	-	-	-	Associated with task 2.5.1
3	2.5.1	Determine distribution and abundance of brook trout	5	USFS, WDFW	25	-	25	-	-	-	Associated with task 2.4.2
3	2.5.2	Encourage brook trout harvest in Pataha Creek	25	USFS, WDFW	*	-	-	-	-	-	Existing agency responsibilities
3	2.5.3	Implement experimental removal of brook trout	5	USFS, WDFW, USFWS	60	-	-	25	25	10	
3	2.6.1	Evaluate potential impacts from fish competition	4	USFS, WDFW	30	-	-	15	15	-	
3	3.2.4	Minimize incidental bull trout mortality from angler-related hooking and handling	25	WDFW	10	5	-	-	-	-	Educational materials at recreation sites; repeat in year 6
3	3.2.5	Use, review, and revise, where necessary, current management goals for bull trout	5	USFS, WDFW, NMFS	*	-	-	-	-	-	Existing agency responsibilities

Implementation schedule for the bull trout recovery plan: Snake River Washington Recovery Unit: Tucannon River Core Area											
Task Priority	Task Number	Task description	Task duration (years)	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
3	4.1.3	Perform genetic analyses on brook trout from Pataha Creek to determine whether hybridization between brook trout and bull trout has occurred	5	USFS, USFWS, WDFW	**	-	-	-	-	-	
3	4.1.4	Monitor genetic changes in numbers and life forms to maintain long-term viability of bull trout in the Snake River Washington Recovery Unit.	25	USFWS	***						See Chapter 1.
3	4.3.1	Evaluate the genetic risks and benefits of reintroduction of bull trout	5	USFWS, WDFW	*	-	-	-	-	-	Cost covered by task 7.3.1
3	5.2.2	Determine whether the hydropower system on the lower Snake River is adversely affecting migratory bull trout in the Tucannon River Core Area	10	WDFW, USACE, USFWS	*	-	-	-	-	-	Existing agency responsibilities

Implementation schedule for the bull trout recovery plan: Snake River Washington Recovery Unit: Tucannon River Core Area											
Task Priority	Task Number	Task description	Task duration (years)	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
3	5.2.3	Conduct feasibility studies for artificial propagation and/or transplantation and implement programs	3	CTUIR, USFS, USFWS, WDFW	10	-	-	10	-	-	Costs also covered by task 7.3.1
3	6.1.1	Identify partnership opportunities	25	CCD, CTUIR, PCD, USFS, USFWS, BPA, WDFW, SRFB, NGO	*	-	-	-	-	-	Tasks also associated with task 7.3.1
3	6.3.1	Work with involved agencies to modify emergency flood repair regulations that may impact bull trout habitat	25	CCD, GCCD, FHA, USFS	*	-	-	-	-	-	Existing agency responsibilities
3	7.3.2	Periodically review progress toward recovery goals and assess recovery task priorities	25	CCD, CTUIR, PCD, USACE, USFS, USFWS, WDFW	*	-	-	-	-	-	

Implementation schedule for the bull trout recovery plan: Snake River Washington Recovery Unit: Asotin Creek Core Area											
Task Priority	Task Number	Task description	Task duration years	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
1	1.1.1	Identify unstable and problem roads causing fine sediment delivery	25	ACCD, USFS, WDOT	10	10	-	-	-	-	Existing agency responsibilities; costs associated with non-agency lands
1	1.1.2	Relocate riparian roads out of the floodplain	25	ACCD, USFS, WDOT	**	-	-	-	-	-	Existing agency responsibilities; costs unknown as each road may require different solutions
1	1.1.3	Find and eliminate fine sediment sources from historical roads	25	ACCD, USFS, WDOT	**	-	-	-	-	-	Existing agency responsibilities;costs unknown as each road may require different solutions
1	1.1.4	Improve routine road maintenance practices	25	ACCD, USFS, WDOT	*	-	-	-	-	-	Existing agency responsibilities
1	1.1.5	Restore stream channels to appropriate channel type	25	ACCD, USFS, WDFW	220	-	-	-	20	200	

Implementation schedule for the bull trout recovery plan: Snake River Washington Recovery Unit: Asotin Creek Core Area											
Task Priority	Task Number	Task description	Task duration years	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
1	1.1.6	Reduce sediment inputs from recreational-based channel damage	25	USFS, WDFW, ACCD, WDNR	*	-	-	-	-	-	Existing agency responsibilities
1	1.1.7	Develop and install educational watershed protection signs in riparian areas of State and Federal campgrounds	3	USFS, WDFW	5	5	-	-	-	-	
1	1.1.8	Review and act on recommendations generated from sediment monitoring plans	25	ACCD, NPT, USFS, WDFW, NRCS	*	-	-	-	-	-	Existing agency responsibilities
1	1.1.9	Assess water quality and remedy impacts from individual residences and communities	25	ACCD, WDOE	*	-	-	-	-	-	Existing agency responsibilities
1	1.1.11	Identify sources and locations of groundwater infiltration to streams	3	ACCD, NRCS, WDFW, WDOE, USFS, USGS	40	20	5	5	5	5	
1	1.1.12	Protect groundwater sources to maintain base flows in Asotin Creek	25	ACCD, EPA, WDOE, WDFW, USFS, NRCS	*	-	-	-	-	-	Existing agency responsibilities

Implementation schedule for the bull trout recovery plan: Snake River Washington Recovery Unit: Asotin Creek Core Area											
Task Priority	Task Number	Task description	Task duration years	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
1	1.1.13	Identify factors contributing to elevated stream temperatures	3	ACCD, WDFW, USFS	*	-	-	-	-	-	Existing agency responsibilities
1	1.2.1	Remove permanent and seasonal barriers to bull trout migration	25	ACCD, WDFW, USFS	*	-	-	-	-	-	Existing agency responsibilities
1	1.2.2	Eliminate barriers to bull trout passage at remnant power and irrigation dams	5	ACCD, WDFW, NRCS	*	-	-	-	-	-	Existing agency responsibilities
1	1.2.3	Conduct a complete inventory of surface water diversions	3	ACCD, WDFW, WDNR, WDOE	5	5	-	-	-	-	
1	1.3.1	Conduct watershed analyses to evaluate past, current, and future bull trout production potential	10	WDFW, USFS, USFWS	*	-	-	-	-	-	Focus on critical habitat and associated waters
1	1.3.2	Identify streambanks susceptible to excessive failure and mass wasting	25	ACCD, WDFW, USFS	*	-	-	-	-	-	Existing agency responsibilities
1	1.3.3	Stabilize streambeds and banks	25	ACCD, NRCS, WDFW, USFS	*	-	-	-	-	-	Existing agency responsibilities

Implementation schedule for the bull trout recovery plan: Snake River Washington Recovery Unit: Asotin Creek Core Area											
Task Priority	Task Number	Task description	Task duration years	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
1	1.3.4	Protect riparian and channel habitat at managed and unmanaged campgrounds, trail systems, and recreation sites	25	USFS, WDFW	*	-	-	-	-	-	Existing agency responsibilities
1	1.3.6	Identify and restore riparian vegetation in priority occupied and unoccupied bull trout habitat	25	ACCD, USFS, WDFW	*	-	-	-	-	-	Existing agency responsibilities
1	1.3.8	Reduce fine sediment inputs from agricultural land	25	ACCD, WDOE, NRCS	*	-	-	-	-	-	Existing agency responsibilities
1	1.3.9	Maintain roadless conditions in sensitive bull trout watersheds	25	USFS	*	-	-	-	-	-	Existing agency responsibilities
1	1.3.10	Evaluate bridge crossings and assess options to modify structures to protect migration corridors	10	ACCD, USFS, WDOT, FHA	*	-	-	-	-	-	Existing agency responsibilities
1	1.3.12	Promote programs to restore and protect floodplain and channel function	25	ACCD, NRCS, WDFW, USFS	*	-	-	-	-	-	Existing agency responsibilities

Implementation schedule for the bull trout recovery plan: Snake River Washington Recovery Unit: Asotin Creek Core Area											
Task Priority	Task Number	Task description	Task duration years	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
1	1.3.13	Identify and restore aggrading stream channels to restore flow and reduce subsurface flows and increase channel stability	25	ACCD, NRCS, WDFW, WDOE, USFS	10	-	10	-	-	-	Surveys only
1	1.3.15	Reduce stream temperatures by enhancing riparian areas	25	ACCD, EPA, WDFW, WDOE, USFS	*	-	-	-	-	-	Existing agency responsibilities
1	1.3.16	Reduce impacts of livestock on streams and riparian areas	25	ACCD, USFS	*	-	-	-	-	-	Existing agency responsibilities
1	1.4.1	Implement bull trout identification protocol at juvenile and adult fishways at Lower Monumental, Little Goose, and Lower Granite Dams	25	USACE	*	-	-	-	-	-	Existing agency responsibilities
1	1.4.2	Review existing bull trout information and determine limiting factors affecting bull trout at Lower Monumental, Little Goose, and Lower Granite Dams	2	USACE, WDFW, USFWS	*	-	-	-	-	-	Existing agency responsibilities

Implementation schedule for the bull trout recovery plan: Snake River Washington Recovery Unit: Asotin Creek Core Area											
Task Priority	Task Number	Task description	Task duration years	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
1	1.4.3	Identify study needs related to habitats for foraging, migrating, and overwintering in Snake River reservoirs	3	USACE, WDFW, USFWS	*	-	-	-	-	-	
1	3.2.1	Reduce incidental harvest by educating recreational anglers and increasing awareness of bull trout population status	25	WDFW	*	-	-	-	-	-	Existing agency responsibilities
1	3.2.2	Summarize existing bull trout bycatch data and implement angler interviews that target bull trout bycatch	25	WDFW	*	-	-	-	-	-	Existing agency responsibilities
1	3.2.3	Increase enforcement patrols during spawning periods	25	WDFW	2	-	-	-	-	-	Increasing need as migratory bull trout increase in abundance and distribution
1	3.4.1	Continue bull trout harvest closure in the Snake River Washington Recovery Unit	25	WDFW	*	-	-	-	-	-	Existing agency responsibilities

Implementation schedule for the bull trout recovery plan: Snake River Washington Recovery Unit: Asotin Creek Core Area											
Task Priority	Task Number	Task description	Task duration years	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
1	4.1.1	Conduct genetic inventory	5	USFS, USFWS, WDFW	15	15	-	-	-	-	
1	4.1.2	Evaluate and describe the genetic structure of bull trout in local populations	5	USFS, USFWS, WDFW	5	5	-	-	-	-	
1	5.2.1	Conduct presence and absence surveys to fully describe the distribution of juvenile, subadult, and adult bull trout	3	USFS, WDFW	60	20	20	20	-	-	
2	1.3.5	Develop and implement comprehensive livestock grazing management plans	25	ACCD, USFS, NRCS	*	-	-	-	-	-	Existing agency responsibilities
2	1.3.11	Incorporate non-intrusive flood repair strategies	25	ACCD, FHA, USFS, WDOT	*	-	-	-	-	-	Existing agency responsibilities
2	1.3.14	Investigate land acquisition as an opportunity to protect bull trout	25	USFS, WDFW	*	-	-	-	-	-	Existing agency responsibilities
2	1.3.17	Minimize further development in floodplains	25	ACCD, WDFW, USFS	*	-	-	-	-	-	Existing agency responsibilities

Implementation schedule for the bull trout recovery plan: Snake River Washington Recovery Unit: Asotin Creek Core Area											
Task Priority	Task Number	Task description	Task duration years	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	1.5.2	Assess current and historical effects of upland management on occupied bull trout streams	5	ACCD, NRCS	*	-	-	-	-	-	Existing agency responsibilities
2	2.1.1	Evaluate potential impacts of hatchery rainbow trout	5	WDFW	*	-	-	-	-	-	Existing agency responsibilities
2	2.4.1	Evaluate impacts of nonnative fish species on bull trout	5	WDFW	*	-	-	-	-	-	Existing agency responsibilities
2	3.2.4	Minimize incidental bull trout mortality from angler-related hooking and handling	25	WDFW	10	5	-	-	-	-	Educational materials at recreation sites; repeat in year 6
2	3.2.5	Use, review, and revise, where necessary, current management goals for bull trout	5	USFS, WDFW	*	-	-	-	-	-	Existing agency responsibilities
2	4.3.1	Perform a genetic cost-to-benefit analysis for reintroduction of bull trout	5	USFWS, WDFW	*	-	-	-	-	-	Covered under task 7.3.1

Implementation schedule for the bull trout recovery plan: Snake River Washington Recovery Unit: Asotin Creek Core Area											
Task Priority	Task Number	Task description	Task duration years	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	5.2.3	Conduct feasibility studies for artificial propagation and/or transplantation and implement programs	5	NPT, USFS, USFWS, WDFW	10	-	-	10	-	-	
2	7.3.2	Periodically review progress toward recovery goals and assess recovery task priorities	25	ACCD, NPT, USACE, USFS, USFWS, WDFW	*	-	-	-	-	-	Existing agency responsibilities
3	1.1.10	Evaluate the need to install additional permanent stream gauging stations	2	WDFW, WDOE, USGS	10	10	-	-	-	-	Costs only for the study
3	1.5.1	Assess effects of upland activities and current upland conditions on stream and riparian function	5	ACCD, NRCS	*	-	-	-	-	-	Existing agency responsibilities
3	1.5.3	Investigate use of prescribed fire	5	USFS	*	-	-	-	-	-	Existing agency responsibilities
3	2.6.1	Evaluate potential impacts from fish competition	5	USFS, WDFW	*	-	-	-	-	-	Existing agency responsibilities

Implementation schedule for the bull trout recovery plan: Snake River Washington Recovery Unit: Asotin Creek Core Area											
Task Priority	Task Number	Task description	Task duration years	Responsible parties	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
3	6.1.1	Identify partnership opportunities	25	ACCD, BPA, NPT, USFS	*	-	-	-	-	-	Costs covered by task 7.3.1
3	7.3.1	Establish a Snake River Washington Recovery Unit bull trout coordinator	1	USFS, USFWS, WDFW	438	35	35	35	35	35	Permanent position for entire recovery unit; see footnote below

For task 7.3.1, funding for a permanent coordinator position would break down as follows:

- years 1 through 5 - half a full-time equivalent
- years 6 through 15 - one-quarter full-time equivalent
- years 16 through 25 - one-eighth full-time equivalent

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Appendix A. List of priority streams in the Tucannon River Core Area. Includes streams with current or recent (last 12 years) bull trout observations (juvenile, subadult, adult, or redds) and potential local populations where bull trout have not been observed but that are identified for their habitat potential and possibility to contribute production toward recovery goals.

Stream	Recent Observations
Upper Tucannon River	**Yes**, redds, adults, juveniles (USFS, *in litt*., 2002)
Panjab Creek	**Yes**, redds, adults (USFS, *in litt*., 2002)
Turkey Creek	**Yes**, redds in 1999 (USFS, *in litt*., 2002)
Meadow Creek	**Yes**, redds in 1999 (USFS, *in litt*., 2002)
Little Turkey Creek	**Yes**, redds in 1999 (USFS, *in litt*., 2002)
Bear Creek	**Yes**, redds, adults, juveniles (USFS, *in litt*., 2002; USFS 1992d)
Sheep Creek	**Yes**, redds, adults, (USFS, *in litt*., 2002)
Cold Creek	**Yes**, redds in 1999 (USFS, *in litt*., 2002), juveniles (USFS 1992f)
Hixon Creek	**Yes**, subadults, no spawning (Mendel, pers. comm. 2002b)
Cummings Creek	**Yes,** juveniles only (USFS 1992b)
Little Tucannon River	**No**, but has **potential** to produce fish
Pataha Creek	**No**, historical presence only, lower 72 km (45 miles) of watershed extremely degraded (Groat, pers. comm. 2002a)

Appendix B. List of priority streams in the Asotin Creek Core Area. Includes streams with current or recent (last 12 years) bull trout observations (juvenile, subadult, adult, or redds) and streams where bull trout have not been observed but that are identified for their habitat potential and possibility to contribute production toward recovery goals.

Stream	Recent Observations
Asotin Creek mainstem (Charley Creek to Forks)	**Yes**, fish only, juvenile rearing and subadults use
North Fork Asotin Creek	**Yes**, redds in 1996 and 1999, juveniles 1992 (USFS, *in litt*., 2002; USFS 1992a)
Cougar Creek	**Yes**, redds in 1996 and 1999, and juvenile rearing (USFS, *in litt*., 2002; USFS 1992g)
Middle Branch of the North Fork	**Yes**, juvenile rearing (USFS 1993b)
South Fork of the North Fork	**Yes**, juveniles only, low numbers (USFS 1993c)
Charley Creek	**Yes**, historical presence, occasional subadult caught electrofishing (USFS 1993a)
George Creek	**No**, but has potential to produce fish
Coombs Creek	**No**, but has potential to produce fish
Hefflefinger Creek	**No**, but has potential to produce fish
Wormell Gulch	**No**, but has potential to produce fish
South Fork Asotin Creek	**No**, but has potential to produce fish

Appendix C. List of prioritized streams in the Tucannon River Core Area. Includes streams where recovery tasks will be implemented and that have the highest likelihood of increasing bull trout production in the overall core area.

Priority	Stream	Priority	Stream
01	Upper Tucannon River	07	Sheep Creek
02	Bear Creek	08	Cold Creek
03	Panjab Creek	09	Little Tucannon River
04	Meadow Creek	10	Cummings Creek
05	Little Turkey Creek	11	Hixon Creek
06	Turkey Creek	12	Pataha Creek

Appendix D. List of prioritized streams in the Asotin Creek Core Area. Includes streams where recovery tasks will be implemented and that have the highest likelihood of increasing bull trout production in the overall core area. Bull trout have not been identified in George Creek, Coombs Creek, Hefflefinger Creek, or lower Wormell Gulch Creek; these streams are identified because they may contain habitat that is suitable for bull trout.

Priority	Stream	Priority	Stream
01	North Fork Asotin Creek	06	Asotin Creek mainstem (Charley Creek to Forks)
02	Cougar Creek	07	George Creek
03	Middle Branch of North Fork Asotin Creek	08	Coombs Creek
04	South Fork of North Fork Asotin Creek	009	Hefflefinger Creek
05	Charley Creek	10	lower Wormell Gulch Creek

APPENDIX E. List of Chapters